BRIEF REPORTS

Microerosion dating of the Shirenzigou Petroglyph Site Complex in the eastern Tianshan Range, northwest China

By JIN ANNI and CHAO GE

The Tianshan Range covers an area in the heartland of the Eurasian continent (Jin et al. 2023). The eastern section of the range had particular significance in a cultural sense, serving as a crossroads between the nomadic cultures from central Asia and southern Siberia (e.g. the Xiongnu, Yuezhi, Wusun, Rouran, Tölö, Türk, Tangut, Khitan), and the agricultural civilisation of the Yellow River Basin. During the past two decades, numerous seasonal settlements, cemeteries and rock art sites have been discovered in the area. According to the authors' rough statistics, 117 rock art site complexes, consisting of more than 11,000 panels with possibly over a million petroglyphs (Fig. 1), have been reported so far (Xinjiang Uygur Autonomous Region Bureau of Cultural Heritage 2011: 3). In recent years, local researchers have reported hundreds of rock art panels on both sides of the mountains. However, compared with their astonishingly vast quantity, the current academic efforts are still meagre, especially considering the absence of scientific studies.

Being aware of the above, the authors have initiated a regional scientific research program, The Eastern Tianshan Range Project (ETRP), focusing on rock art since 2020. The basic goal of the ETRP is to establish a statistically significant dataset of age estimates through testable and repeatable means and to reveal the technical details of the rock art tradition by applying experimental methods. The first attempt was conducted at the Hongshankou petroglyph site complex, as presented in Volume 40 of *RAR* (Jin et al. 2023). This paper aims to report on the progress of the program in 2021 and 2022 at the Shirenzigou petroglyph site complex near Barkol Kazakh Autonomous County, Xinjiang Uyghur Autonomous Region, northwest China.

The Shirenzigou archaeological site complex is situated to the south of Shirenzi Village, approximately 23 km east of the county seat (Barkol). The site complex spans two valleys—Shirenzigou and Zhigou—and the hillside slopes in front of the mountains. It stretches about 5 km from north to south and about 3.5 km from east to west, forming a fan-shaped area covering roughly 8.75 km² (Fig. 2). In 2005, a comprehensive survey of the site area was conducted by the School of Cultural Heritage at Northwest University, in collaboration with local authorities. The survey revealed three large groups of stone architectural foundations, 140 smaller stone house foundations, 1666 burials and 2480 petroglyph sites[1] (Xinjiang Institute of Archaeology and Research Centre of Cultural Heritage and Archaeology at Northwest University 2009; School of Cultural Heritage at Northwest University et al. 2021).

The petroglyph sites were predominantly found in the northern part of the entire archaeological site area, especially within the dense rocky grasslands flanking the alluvial fan formed by seasonal flash floods from

1 'Site' here refers to 'a single rock or an outcrop bearing rock art panels'.

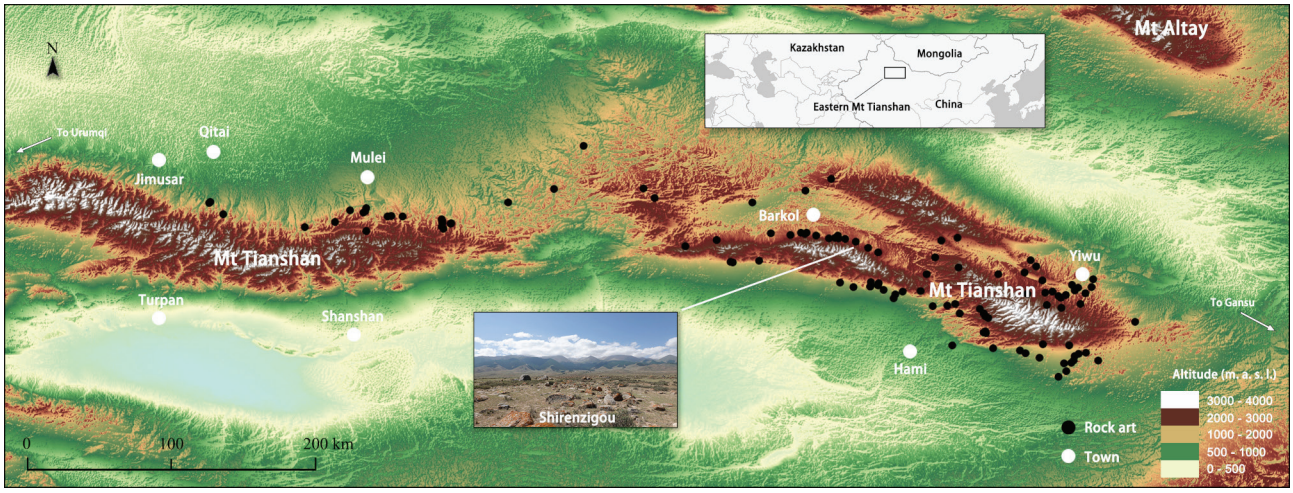


Figure 1. *Rock art site complexes in the eastern Tianshan Range, Xinjiang, northwest China.*

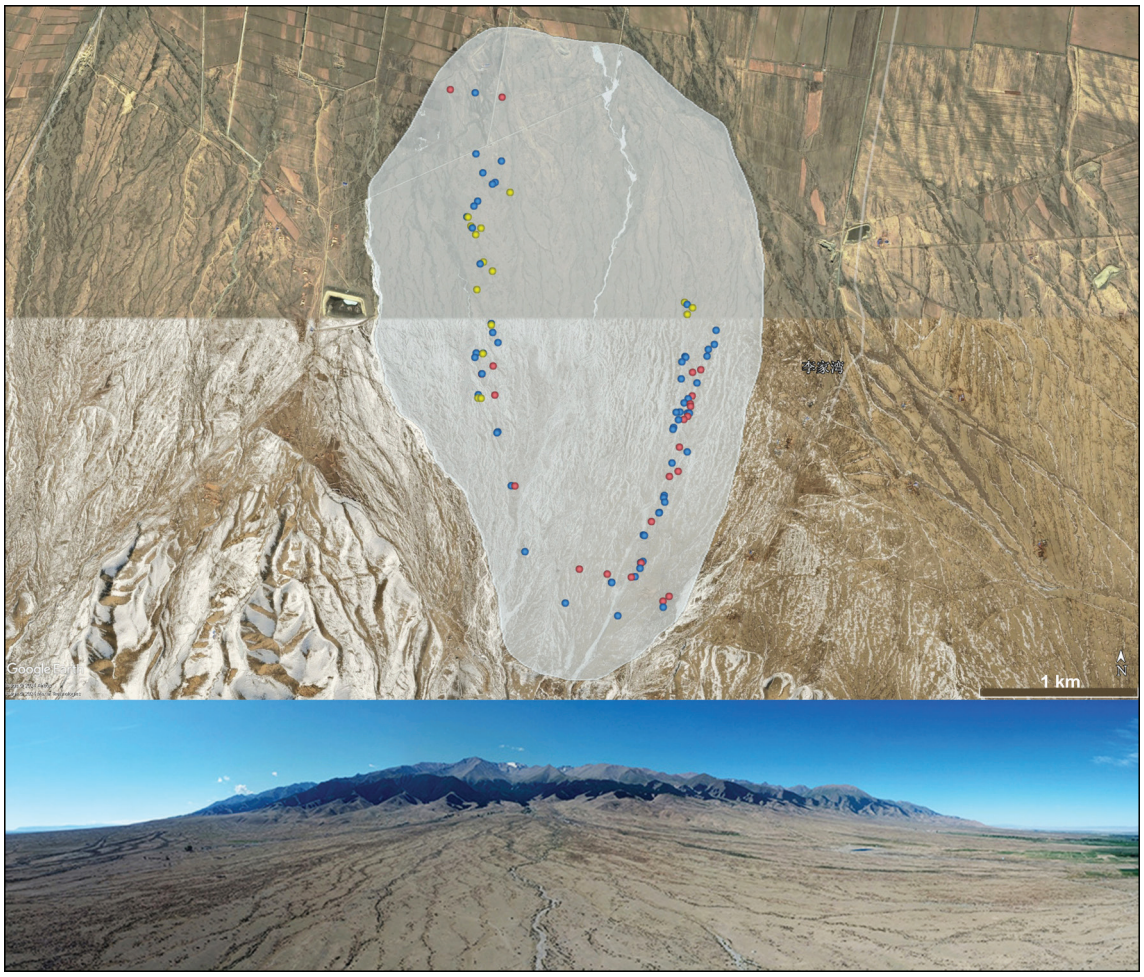


Figure 2. *The study area of the Shirenzigou rock art site complex. Upper image: the distribution of studied sites; the red and yellow dots represent the sites where micro-wane data were secured in 2021 and 2022, respectively, and the blue ones indicate the sites unsuitable for direct dating. Lower image: the aerial view of the entire study area, photographed by a UAV, seeing from the north).*

the mountains. Almost all the motifs were produced on the rock varnish layer, using a technique known as 'sgraffito', and the most common type of host rock is granite (over 40%), followed by gabbro and diorite. In 2021 and 2022, the authors conducted surveys and field microscopy of 99 rock art sites (granite), examining 653 petroglyph motifs on 127 rock art panels. Animal-like motifs overwhelmingly dominate in quantity (565 motifs), accounting for about 86.5% of the total. Recognisable species include sheep, deer, horses, cattle, dogs and camels, all common in the eastern Tianshan region. Notably, sheep-like motifs number as high as 481, representing about 85.1% of all animal-like motifs. Most of the sheep-like figures feature horns that curve backward in an arc, possibly emulating the Siberian ibex (*Capra sibirica*). In contrast, others have horns that spiral backward from the top of the head, suggesting the argali sheep (*Ovis ammon*). The rest, such as anthropomorphs, object-like, geometric and symbolic motifs, are less frequent, constituting about 13.5% of the total. Three styles have been observed: linear, silhouetted and outlined, with linear being the most popular, accounting for 61.9%, and silhouetted and outlined art comprising 25.6% and 12.5%, respectively (Fig. 3).

In our field microscopy, we used a monocular microscope with a fixed 100× magnification lens (Model: JNOEC XC100) to scrutinise the micro-topography of rock surfaces and markings. We also used it to identify the precise locations of micro-wanes (Fig. 4). The examination was supplemented with a 20× optical magnifier for initial observations and a 40–200× digital lens (Model: MDA-2000) for capturing high-resolution photographic records. After two years of meticulous effort, the authors have successfully collected 65 sets of micro-wane data from crystalline quartz samples obtained from 61 motifs on 44 panels across 38 rock art sites.

As mentioned in the first published field report of this program (Jin et al. 2023), the absence of suitable dated inscriptions in the region necessitates the use of the Universal Calibration Curve (UCC, see Beaumont and Bednarik 2015; Bednarik 2019) as the sole viable solution for calibration. Barkol County encompasses a diverse array of terrains such as mountains, deserts, highlands, basins and valleys. These topographical

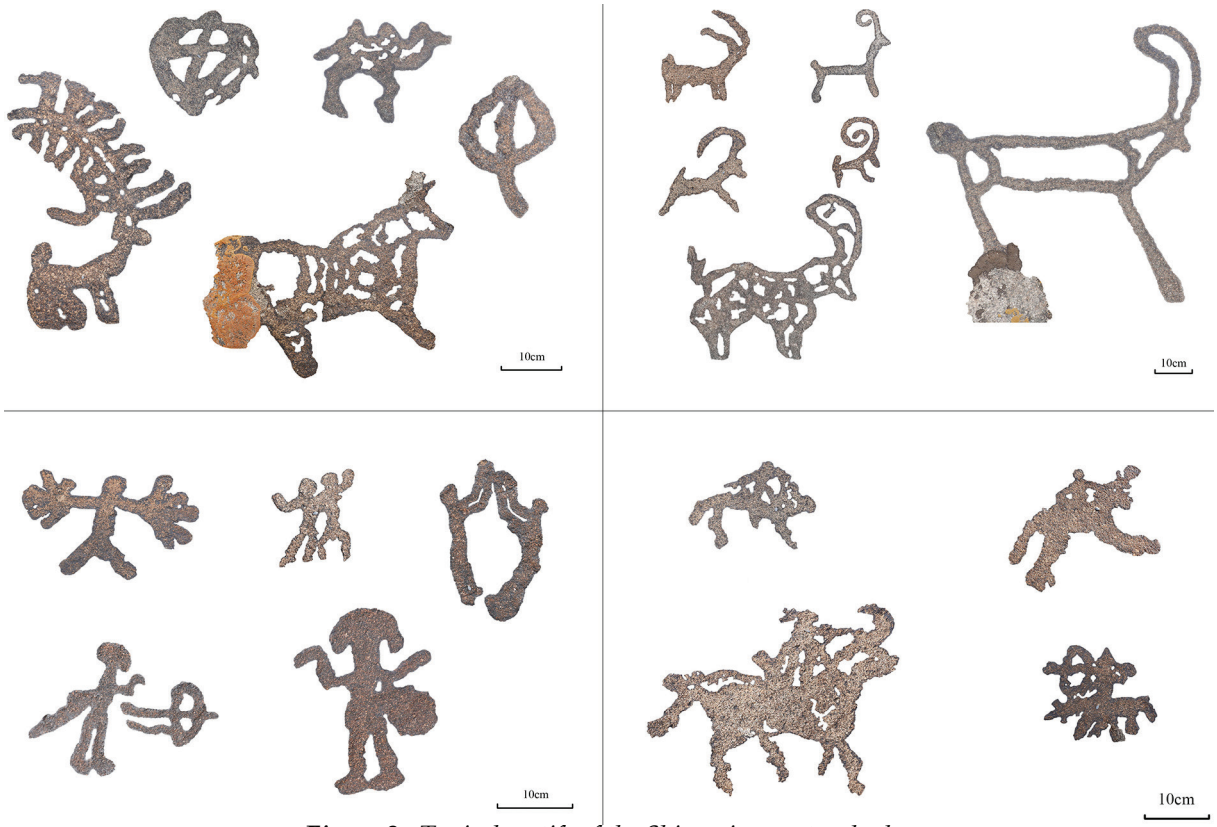


Figure 3. *Typical motifs of the Shirenzigou petroglyphs.*

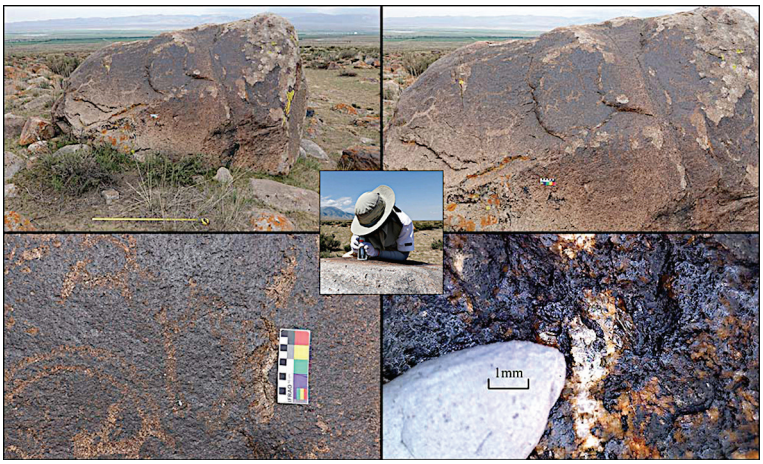


Figure 4. *Field microscopy of rock art site (SRZ-12).*

features have significantly shaped the regional climate, particularly in the high-altitude mountain area where the studied rock art site complex lies. Precipitation patterns exhibit a distinct vertical gradient, with TRMM annual precipitation data indicating a marked increase in rainfall as altitude rises along the northern slopes of the Tianshan Mountains, with an average annual increase in precipitation of 11.0 mm/100 m of elevation gain (Liu et al. 2011). Focusing on the warm-season precipitation, data reveals a linear correlation between precipitation levels and altitude in the great Hami area (including Hami City, Barkol County and Yiwu County), with the highest rainfall—ranging from 240 to 350 mm—occurring at elevations between 2100 and 2500 m a.s.l. In the Barkol Basin, situated between 1800 and 2100 m a.s.l., warm-season precipitation amounts to 200 to 240 mm, with an increase of approximately 12.3 mm for every additional 100 m of elevation (Bai et al. 2023). Drawing from long-term data collected at the Barkol meteorological station (1650.9 m a.s.l.), the county town experiences an annual average precipitation of 210 to 230 mm (Zhang et al. 2009; Zhuo and Feng 2013; Li 2014; Peng et al. 2019). In contrast, Barkol Lake, located about 18 km west of the town at an elevation of 1580 m, records a significantly lower annual average precipitation of 202 mm compared to the town (Cao et al. 2015).

Given that the studied rock art site complex is positioned at an altitude of approximately 2000 m a.s.l., utilising precipitation data from Barkol County town or Barkol Lake would introduce substantial errors. Consequently, the authors opted for the multi-year average annual precipitation data from the Songshutang meteorological station located about 30 km east of the site complex in Baishitou township, which shares similar environmental conditions and an altitude (2103 m a.s.l.) close to that of Shirenzigou. Utilising the station's long-term average annual precipitation of 298.4 mm (Guo 2010) in conjunction with the universal curve yielded a coefficient of 4.2 μm/ka.

Following the calibration process, the scientists have amassed a total of 65 microerosion age estimates (Table 1). Within this dataset, there are 12 results that

Site	Motif	Style	Micro-wane No.	Wane length & widths (μm)	Age estimate (BP)
SRZ-1	'human'	silhouetted	China-Shirenzi1-EQ-14/7/2021	80; 8/9/10/11/10/10/9/9	E2260±360
SRZ-3	'sheep'	outlined	China-Shirenzi3a-EQ-14/7/2021	60; 9/10/10/11/12/10	E2460+400/-320
	'sheep'	outlined	China-Shirenzi3b-EQ-14/7/2021	80; 12/12/10/13/15/14/14/15/13	E3120+450/-740
SRZ-5	'sheep'	silhouetted	China-Shirenzi5a-EQ-14/7/2021	70; 12/12/11/11/13/13/11/10/11/11/10	E2700+400/-320
	'sheep'	silhouetted	China-Shirenzi5b-EQ-14/7/2021	80; 12/12/11/12/12/13/13/12/11/10	E2810+290/-430
	'sheep'	linear	China-Shirenzi5c-EQ-14/7/2021	100; 13/13/14/14/13/12/12/10/10/10/10	E2830+500/-450
SRZ-9	'horseman'	silhouetted	China-Shirenzi9-EQ-14/7/2021	70; 12/12/13/13/14/15/15/14/13/13/11	E3140+430/-520
SRZ-12	'sheep'	silhouetted	China-Shirenzi12a-EQ-14/7/2021	100; 10/9/8/10/10/10/11/11/10/9/9/8	E2280+340/-380
	'sheep'	silhouetted	China-Shirenzi12b-EQ-14/7/2021	60; 11/10/10/10/9/10/9/8	E2290+330/-390
	'sheep'	silhouetted	China-Shirenzi12c-EQ-14/7/2021	100; 12/12/11/10/12/12/13/12/11/10	E2740±360
	'human'	silhouetted	China-Shirenzi12d-EQ-14/7/2021	120; 15/14/13/12/14/15/15/14/14	E3330+240/-470
SRZ-13	'deer'	outlined	China-Shirenzi13a-EQ-14/7/2021	70; 12/11/10/10/11/11/10/10/9/10/11/11	E2500±360
	'deer'	outlined	China-Shirenzi13b-EQ-14/7/2021	100; 9/10/10/11/11/10/10/11/10/10/9/10	E2400+220/-260
	'tiger'	outlined	China-Shirenzi13c-EQ-14/7/2021	200; 9/9/10/10/10/11/11/12/10/11/10/9/10/9/9/9	E2370+490/-230
SRZ-15	'animal'	linear	China-Shirenzi15-EQ-14/7/2021	70; 6/8/8/7/6/6/7/8/7	E1670+230/-240
SRZ-16	'wolf'	outlined	China-Shirenzi16-EQ-14/7/2021	100; 13/13/13/12/12/11/11/13/10/10/10/10/10	E2710+390/-330
SRZ-17	'sheep'	linear	China-Shirenzi17a-EQ-14/7/2021	50; 8/9/8/10/11/11/10/10/9	E2280+340/-380
	'sheep'	outlined	China-Shirenzi17b-EQ-14/7/2021	50; 6/7/7/8/10/9/8/7	E1850+530/-420
SRZ-18	'horseman'	silhouetted	China-Shirenzi18-EQ-14/7/2021	80; 10/10/11/11/12/12/11/11/10/9	E2550+310/-410
SRZ-20	'sheep'	outlined	China-Shirenzi20-EQ-17/7/2021	90; 8/9/8/9/10/11/10/10/9	E2220+400/-320
SRZ-21	'sheep'	linear	China-Shirenzi21-EQ-17/7/2021	100; 11/11/10/10/10/9/10/9/8/8/7	E2230+390/-560
SRZ-27	'sheep'	linear	China-Shirenzi27-EQ-17/7/2021	60; 7/8/9/9/8/8/7/7	E1880+260/-210
SRZ-33	'sheep'	silhouetted	China-Shirenzi33a-EQ-17/7/2021	70; 10/11/12/12/13/11/10/10/9/9	E2550+550/-410
	'sheep'	linear	China-Shirenzi33b-EQ-17/7/2021	120; 9/9/10/10/9/10/11/10/9/8	E2260±360
SRZ-34	'sheep'	outlined	China-Shirenzi34a-EQ-27/7/2021	150; 9/10/11/11/12/10/9/11/12/11/10/9/10/11	E2480+380/-340
	'sheep'	outlined	China-Shirenzi34b-EQ-27/7/2021	60; 12/12/11/10/10/9/9/8	E2410+450/-510
	'sheep'	outlined	China-Shirenzi34c-EQ-27/7/2021	100; 11/11/9/9/10/10/10/10/11/10/10/9	E2380±240
SRZ-36	'sheep'	linear	China-Shirenzi36a-EQ-23/7/2021	60; 8/8/9/10/10/11/10/9/9/9	E2210+410/-310
	'sheep'	silhouetted	China-Shirenzi36b-EQ-23/7/2021	50; 10/11/11/12/10/10/9	E2480+380/-340
SRZ-37	'sheep'	silhouetted	China-Shirenzi37-EQ-23/7/2021	80; 6/7/9/9/8/9/8/9	E1940+200/-510
SRZ-38	'sheep'	linear	China-Shirenzi38a-EQ-23/7/2021	120; 9/10/10/9/8/10/10/11/10/10/9/8	E2260±360
	'sheep'	linear	China-Shirenzi38b-EQ-23/7/2021	60; 10/11/10/10/9/10/9/8	E2290+330/-390
	'sheep'	linear	China-Shirenzi38c-EQ-23/7/2021	80; 8/10/10/11/12/12/11/11/10/9/8	E2420+440/-520
	'sheep'	linear	China-Shirenzi38d-EQ-23/7/2021	50; 10/11/12/13/13/11/11/10	E2710+390/-330
SRZ-51	'sheep'	linear	China-Shirenzi51-EQ-27/7/2021	70; 7/7/8/10/11/12/11/10/9	E2250+610/-580
SRZ-52	'horseman'	silhouetted	China-Shirenzi52-EQ-27/7/2021	100; 8/8/7/8/9/8/10/10/9/8	E2020+360/-350
SRZ-56	'sheep'	linear	China-Shirenzi56a-EQ-27/7/2021	70; 7/8/9/9/10/10/11/11	E2230+390/-560
	'sheep'	linear	China-Shirenzi56b-EQ-27/7/2021	50; 6/7/8/10/9/8	E1900+480/-470
	'archer'	silhouetted	China-Shirenzi56c-EQ-27/7/2021	70; 10/10/9/8/8/7/8	E2040+340/-370
SRZ-59	'sheep'	silhouetted	China-Shirenzi59a-EQ-27/7/2021	60; 8/9/10/10/9/10/8	E2180+200/-280
	'sheep'	outlined	China-Shirenzi59b-EQ-27/7/2021	40; 10/10/9/10/11/10	E2380±240
SRZ-60	'horseman'	silhouetted	China-Shirenzi60-EQ-27/7/2021	70; 9/10/10/11/10/10/9/9/8	E2280+340/-380
SRZ-65	'sheep'	silhouetted	China-Shirenzi65a-EQ-27/6/2022	60; 7/8/9/9/10/9/10	E2110+270/-440
	'sheep'	silhouetted	China-Shirenzi65b-EQ-27/6/2022	130; 8/9/10/10/11/11/10/10/11/12/12	E2470+390/-570
SRZ-66	'sheep'	outlined	China-Shirenzi66-EQ-27/6/2022	90; 10/10/11/9/9/8/7/7/8	E2090+530/-420
SRZ-68	'horseman'	silhouetted	China-Shirenzi68a-EQ-27/6/2022	50; 6/7/7/8/7/7/6	E1630+270/-200
	'sheep'	linear	China-Shirenzi68b-EQ-27/6/2022	80; 10/11/10/9/8/8/8/9/10	E2200+420/-300
SRZ-74	'sheep'	outlined	China-Shirenzi74-EQ-28/6/2022	100; 6/7/9/9/10/11/10/9/8/7	E2050+570/-620
SRZ-77	'archer'	silhouetted	China-Shirenzi77-EQ-28/6/2022	50; 7/6/7/8/7/6	E1630+270/-200
SRZ-79	'sheep'	outlined	China-Shirenzi79-EQ-28/6/2022	60; 7/7/8/8/9/8/7	E1840+300/-170
SRZ-81	'sheep'	linear	China-Shirenzi81a-EQ-28/6/2022	50; 9/8/9/9/10/10/9	E2180+200/-280
	'wheel'	linear	China-Shirenzi81b-EQ-28/6/2022	60; 6/7/9/9/8/6	E1790+350/-360
SRZ-82	'sheep'	outlined	China-Shirenzi82a-EQ-28/6/2022	50; 8/9/8/7/7/7	E1830+310/-160
	'sheep'	outlined	China-Shirenzi82b-EQ-28/6/2022	100; 9/8/9/10/11/12/10/10/9/10	E2330+530/-430
	'sheep'	silhouetted	China-Shirenzi82c-EQ-28/6/2022	60; 9/9/8/10/10/10/9	E2210+170/-310
SRZ-84	'horseman'	silhouetted	China-Shirenzi84a-EQ-28/6/2022	70; 8/9/8/8/9/9/10/11/10	E2170+450/-270
	'sheep'	linear	China-Shirenzi84b-EQ-28/6/2022	100; 9/9/10/10/10/11/11/10/9/9/8	E2300+320/-400
SRZ-85	'deer'	outlined	China-Shirenzi85a-EQ-28/6/2022	50; 9/8/9/10/10/9	E2180+200/-280
	'sheep'	silhouetted	China-Shirenzi85b-EQ-28/6/2022	100; 7/8/8/7/8/9/9/10/8/7	E1930+450/-260
SRZ-86	'sheep'	outlined	China-Shirenzi86a-EQ-28/6/2022	50; 8/9/10/10/9/9/8	E2140±240
	'sheep'	outlined	China-Shirenzi86b-EQ-28/6/2022	90; 11/10/10/9/10/9/8/8/9/10	E2240+380/-340

SRZ-87	'sheep'	outlined	China-Shirenzi87-EQ-28/6/2022	80; 12/11/9/9/10/9/9/8/7	E2220+640/-550
SRZ-92	'sheep'	linear	China-Shirenzi92-EQ-29/6/2022	60; 8/8/7/6/6/7/6	E1630+270/-200
SRZ-96	'sheep'	outlined	China-Shirenzi96-EQ-29/6/2022	90; 10/11/10/11/11/10/9/9/8/8	E2310+310/-410
SRZ-97	'deer'	linear	China-Shirenzi97-EQ-29/6/2022	70; 11/10/10/10/9/8/7/7	E2140+480/-470

Table 1. *The microerosion dating results from Shirenzigou of the surveys in 2021 and 2022.*

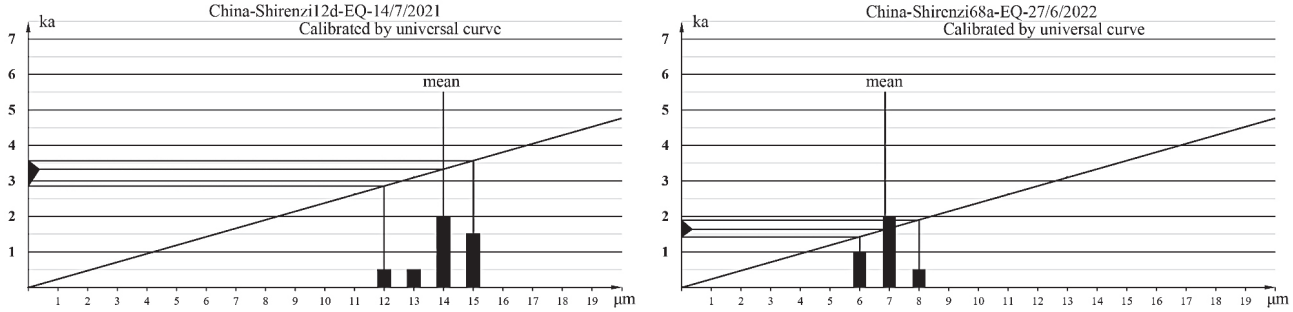


Figure 5. *Microerosion age estimates from SRZ-12 and SRZ-68.*

fall between 1000 and 1999 years BP (18.5% of the total), 50 estimates ranging from 2000 to 2999 years BP (76.9%), and a mere three estimates earlier than 3000 years BP (4.6%). Notably, four motifs have yielded double estimates, specifically at SRZ-3, SRZ-5, SRZ-12 and SRZ-13. The later dates probably imply re-impact events, which could be due to additional weathering or human activity. The earliest age estimate, from a linear anthropomorph at SRZ-12, is E3330+240/-470 years BP ('P' indicates the year 2021 CE), while the most recent estimate, E1630+270/-200 years BP ('P' refers to the year 2022 CE), came from three motifs at different sites: SRZ-68 (a silhouetted 'horseman'), SRZ-77 (a silhouetted 'archer') and SRZ-92 (a linear 'sheep') (Fig. 5). It seems that the creation or production of rock art roughly spans from the 14th century BCE to the 4th century CE, marking an impressive tradition lasting for 1700 years.

In accordance with the IFRAO Code of Ethics, the coordinates of the sites are not disclosed in this paper. However, to ensure verifiability and repeatability, the authors are willing to share specific information, such as the sites' location and the position of observed crystals on the panels with colleagues who require it. Due to space limitations, further details about the Shirenzigou rock art will be presented in a future research article that addresses regional issues.

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RAR 42-1474

The memory of the Talabre Geoglyphs in the Atacama Desert: the past is ahead, the future behind us

By GONZALO PIMENTEL G., MARIANA UGARTE F., JUAN GILI H., JAVIER ARÉVALO L. and CLAUDIA MONTERO P.

The Talabre geoglyphs carry a millennia-old memory that transcends their figures. They are remnants of the ancient trans-desert caravanners and have been silent witnesses to all subsequent history up to the present day. In this work, we present part of their becoming to the present, including their recent 'restoration'.

Unlike Western thought—which conceives the past behind our backs—Andean people envision the past ahead of them: it is represented ahead because it encompasses what has been seen, known and experienced. There are, for example, their ancestors. It is the future, however, that is behind us, behind our backs, because it corresponds to what is unknown and uncertain. An Aymara aphorism summarises it this way: 'By looking back and ahead (to the future-past), we can walk in the present-future' (in Aymara: *Qhipnayra uñtasis sarnaqapxañani*, in Rivera Cusicanqui 2015: 11; translation is ours).

The Talabre geoglyphs hold an ancient memory that is ahead of them, behind them, and all around them. They possess their own assemblage in the Deleuzian sense, which always refers to multiplicity, heterogeneity and symbiosis: 'It is a multiplicity which is made up of many heterogeneous terms and which establishes liaisons, relations between them, across ages, sexes and reigns—different natures' (Deleuze and Parnet 1987 [1977]: 69). A historical example is the invention of the stirrup, which, by enabling an army

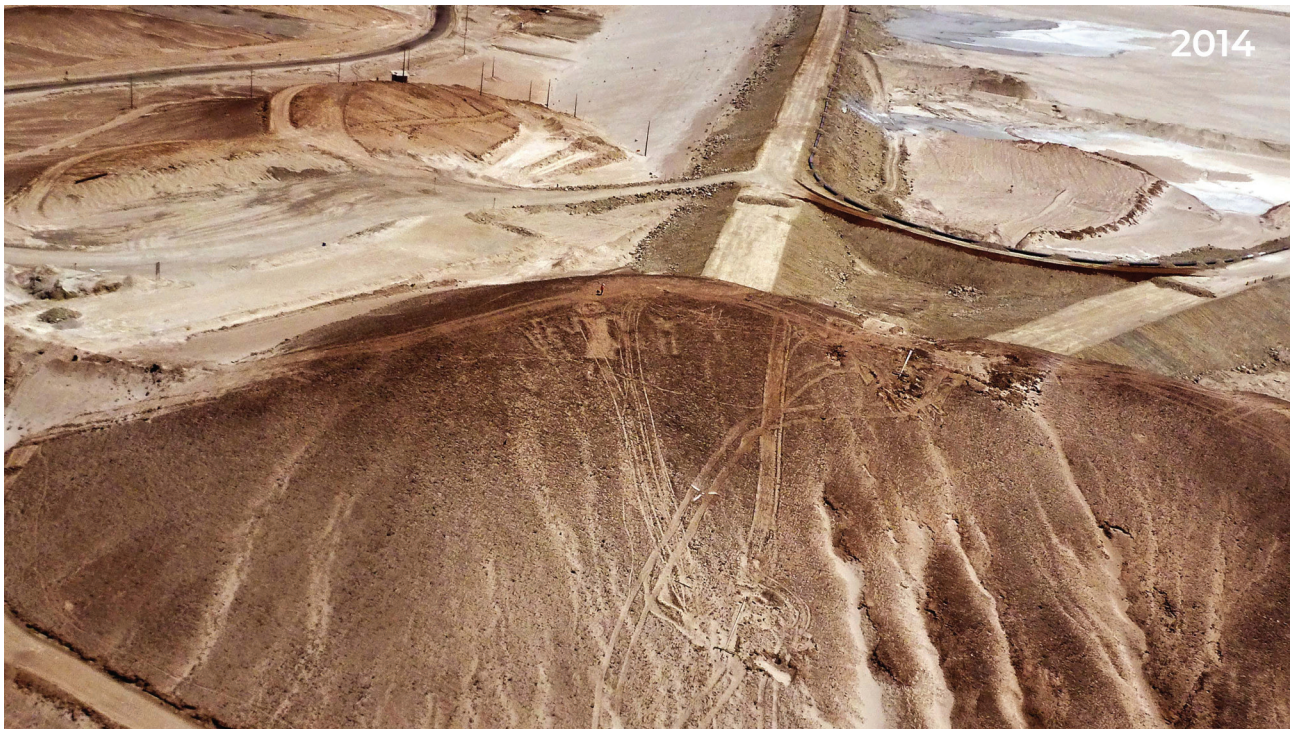


Figure 1. *Aerial image of the Talabre Geoglyphs (2014). Source: Fundación Desierto de Atacama archive.*



Figure 2. *Satellite image of the Talabre tailings dam (CODELCO), Calama, Antofagasta region, Chile (Google Earth 2009). By 2019, the dam had a surface area of 70 km^2, a storage volume of 1480 million m^3 and a load of approximately 232,000 tonnes of tailings per day. In the foreground, the hill with the Talabre Geoglyphs.*

of riders to rise on the stirrups of a galloping horse and freely use their hands for attacking with bows and arrows, created the first great war machine. In an assemblage of this kind (stirrup-horse-riders-bow/arrow-army-speed-war), one of its main characteristics is the collective formation of a combined, symbiotic relationship that is multispecies and multimaterial (Deleuze and Guattari 1987 [1980]).

The Atacama geoglyphs are the visual product of an assemblage of multiple relationships between their monumental figures and their imaginative potentialities, with the mountain as a material canvas and its prominence in the landscape, with the pathways as axes for transit and observation, with the llama caravans as a mode of travel, and the intentionality of the artists in the formal construction of motifs and their meanings. Furthermore, they can be appreciated as transtemporal, as their agency transcends their historical time. Even though several components of their original assemblage—such as the caravans, the meaning of their messages, or the integrity of their figures—have disappeared or transformed, they not only endure through time but also incorporate new relationships, contexts and agencies. This is evident in the case of the Talabre Geoglyphs, presented here: a site recently recognised in 2013, which holds its own diachronic memory and even a unique relationship with the contemporary copper mining industry (Fig. 1).

The Talabre Geoglyphs

Located a few kilometres from the current city of Calama in northern Chile, the Talabre salt flat was an extensive lagoon around 10,000 years ago, which in addition to hosting a significant diversity of fauna and flora in the midst of the desert, had high-quality siliceous lithic quarries, making this place a true paradise for hunter-gatherer groups. It gradually transformed into a salt flat, with small lagoons surviving within it. For the caravanners who were travelling its edges about 3000 years ago, it was also a strategic place for resupplying and resting during their journeys (e.g. Le Paige 1959; Lanning and Patterson 1967; Núñez 1967; Pimentel 2009, 2013).

At this time, they begin to make the first geoglyphs in this desert and then create the largest human figure in the Talabre panel, measuring almost 17 metres in length. With curvilinear lines, they represented its body frontally and its legs in profile as if walking, featuring a subcircular head and concave clothing that shows a lower hook. Its mouth, nose and eyes were represented, its arms down, and its right arm held a rod or similar element. Due to its monumentality and centrality, it seems to represent an ancient Andean deity.

It was around 2000 years later (c. 1000 BP), during a time marked by the agro-hydraulic revolution, droughts and wars across most of the Andes, that the other two human figures flanking the central anthropomorph were likely created, as this period is characterised by the depiction of human figures with straight lines, rigid postures, frontal perspectives and a lack of animation, emphasising clothing and headdress as diacritical elements of intergroup distinction (e.g. Berenguer 2004a, 2004b; Pimentel 2011; Gallardo et al. 2012; Gallardo 2018). Thus, their clothing was marked with distinctive shapes, apparently representing different Andean groups.

If you had travelled through Talabre 1000 or 500 years ago, on the llama caravan trails (*Lama glama*), you



Figure 3. *Aerial photogrammetry of the Talabre Giant (2014). Source: Fundación Desierto de Atacama archive.*

would have seen these images clearly, like true guides left by the ancients. They were there while Pedro de Valdivia—the 'Conqueror of Chile'—and his forces advanced south to begin the European invasion of those territories almost 500 years ago. They remained there in the 19th century while nation-states appeared, first becoming part of Bolivia and then being occupied in 1879 by the Chilean army.

They were still there when large-scale copper mining began in Chuquicamata in the early 20th century. But here we must pause because the extractive history has left deep scars on their very bodies, on the hill, and especially on the salt flat and life, sadly in a rapidly short time.

The hundreds of millions of tonnes of toxic waste produced by copper extraction began to be dumped into the natural basin of the salt flat. Thus, from one day to the next, from a lagoon and salt flat, Talabre became a giant tailings dam, currently managed by the state copper mining company, CODELCO.



Figure 4. *Detail of the motifs. Source: Fundación Desierto de Atacama archive.*

And so, the lagoon and the salt flat were completely flooded with water contaminated by heavy metals. But the Talabre Geoglyphs have magically survived, even though trucks and heavy machinery have left their marks on them, even though roads and tailings walls have been built nearby, and even though electric towers and other disturbances were installed. Nevertheless, they could not make them disappear. They endure with im-

pressive persistence: there they remain, almost blurred, with their ancient presence, fragility and simplicity, bearing the new modern marks like true scars on their bodies, as a tangible memory of a past that is imagined ahead (Figs 3 and 4).

In April 2019, the company CODELCO publicly celebrated the 'restoration' of the Talabre Geoglyphs (Figs 5 and 6). They erased the vehicle tracks from the panel, 'restored' them and fenced off the figures. After the 'restoration', we can observe in the central figure (motif 1) that the hook, previously shown at the bottom of its clothing, has disappeared and is now hidden beneath the skirt. Its two arms, which were originally pointing downward, now point upward, after its rod was interpreted as its right forearm and its left forearm was simply added.

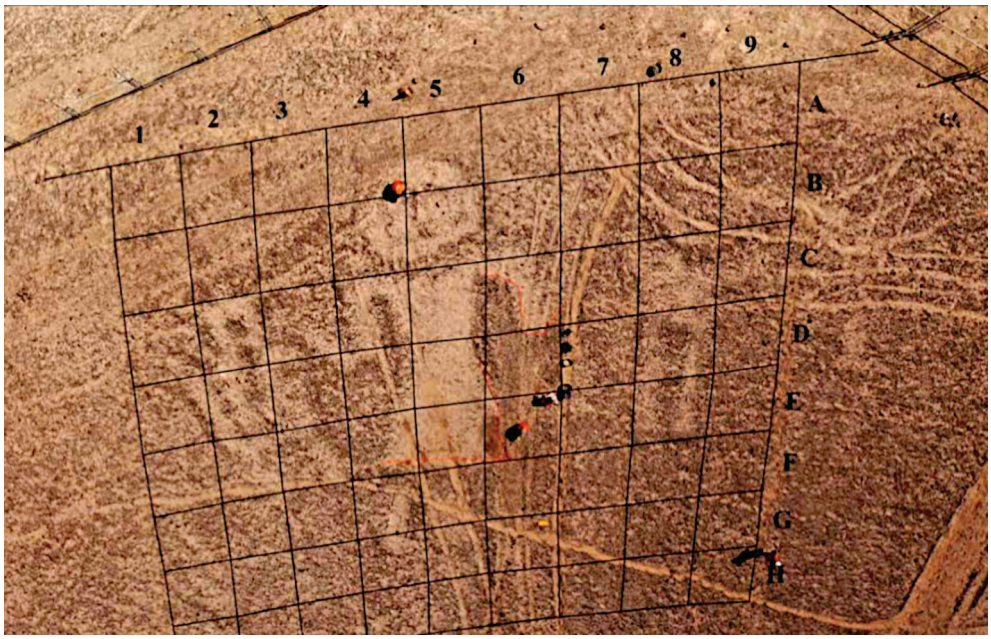


Figure 5. *Restoration process of the geoglyphs by the mining company CODELCO. Note the red outline used to delineate the figures (Source: CODELCO 2024: 31).*

The figure to its right (motif 3) also underwent figurative changes compared to the original design. Its head, originally square in shape with a central accumulation, was expanded laterally to form a rectangle with a double central accumulation, erasing in this gesture the vertical appendage that detached from its right shoulder. As for the figure to its left (motif 2), its circular head was finally completely erased. Thus, all three anthropomorphous figures in this panel underwent multiple transformations during the 'restorative' process.

Conclusions

While only its façade is retouched and transformed,



Figure 6. *Aerial photograph of the completed 'restoration' of the Talabre Geoglyphs. Source: Fundación Desierto de Atacama archive.*

behind its back, in the metaphor of the future of the Andean people, a heavy, metallically contaminated environment is revealed—lifeless, filled with death and amnesia of the past.

On the contrary, the Talabre geoglyphs, with their millennia-old memory and diachronic assemblages, seem to be agents of a future in which all times have a place, with the future-past, with backward and forward ...

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RAR 42-1475

Las Losas: a horizontal rock art site on the coast of the Atacama Region, northern Chile

By BENJAMÍN BALLESTER, FERNANDO BASTÍAS, GLORIA CABELLO, ELISITA BALBONTÍN, ELISITA DOMÍNGUEZ, PATRICIA DOMÍNGUEZ and BENJAMÍN MOLINA

Introduction

The discovery of a horizontal rock art site located on the coast of the Atacama region in northern Chile is presented. It is a unique site, as no other similar sites are currently known in the region. This preliminary report makes its location, dimensions, manufacturing technique, number of motifs, arrangement and iconographic characteristics public. Finally, the finding is discussed in relation to another similar unpublished case and to the rock art traditions of this section of the Atacama Desert.

The majority of rock art is executed on vertical supports that facilitate its observation from a frontal perspective. However, there are also rock art manifestations made on inclined or completely horizontal, pavement supports intended to be observed in the zenith, nadir or oblique viewpoints, such as on the roof of caves and rockshelters, as well as on their floors or directly on the ground in open-air sites. Among the latter, the most popular are probably the geoglyphs, many of which are so large that they are truly monumental visual masterpieces. Unfortunately, due to their location on the ground, they are subject to various environmental and human factors that may affect their preservation and study at present.

The Atacama Desert in northern Chile is a privileged place for the conservation of these visual manifestations in their different variants, due to the low erosion of its soils and the large areas still uninhabited. Notwithstanding, apart from the large and popular geoglyphs, there are practically no references to horizontal or flat rock art sites in northern Chile. We

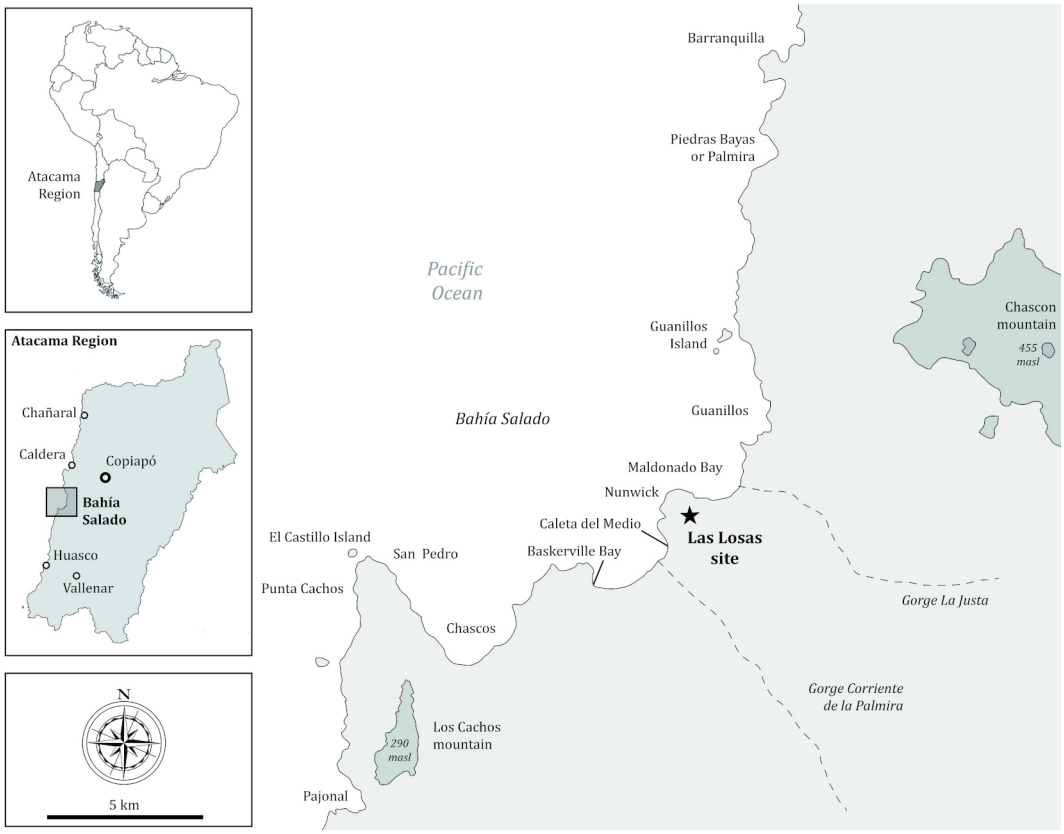


Figure 1. Map of the study area.

present the preliminary report of a unique finding in the region, given that it is one of the first sites of these characteristics known so far, whose preservation has occurred thanks to its location within a dune field which, with the wind, has covered it and protected it from the various environmental and human factors.

Site characteristics: location, composition and motifs

The rock art site of Las Losas is located on the coast of the Atacama region, in northern Chile, in the interfluve between the Copiapó and Huasco rivers. Although there is a history of painted and engraved rock art in this area, this particular site has not been documented, mainly due to the lack of systematic research and the difficulty of access to the area (Niemeyer 1955; Iribarren 1957, 1958, 1968a, 1968b, 1973a, 1973b; Mulet and Sanguinetti 1958; Niemeyer and Montané 1968; Castillo 1985; Cervellino 1985; Arévalo and Arancibia 2020). Specifically, it is placed in the sector called Punta Nunwick (also known as Punta Hardy), a small peninsula that separates Caleta del Medio from Bahía Maldonado, right in the centre of Bahía Salado (Fig. 1). The Punta Nunwick sector is no



Figure 2. Aerial views of the site of Las Losas: (A) drone photograph looking south; (B) zenithal view distinguishing the main sectors of concentration of rock art motifs.

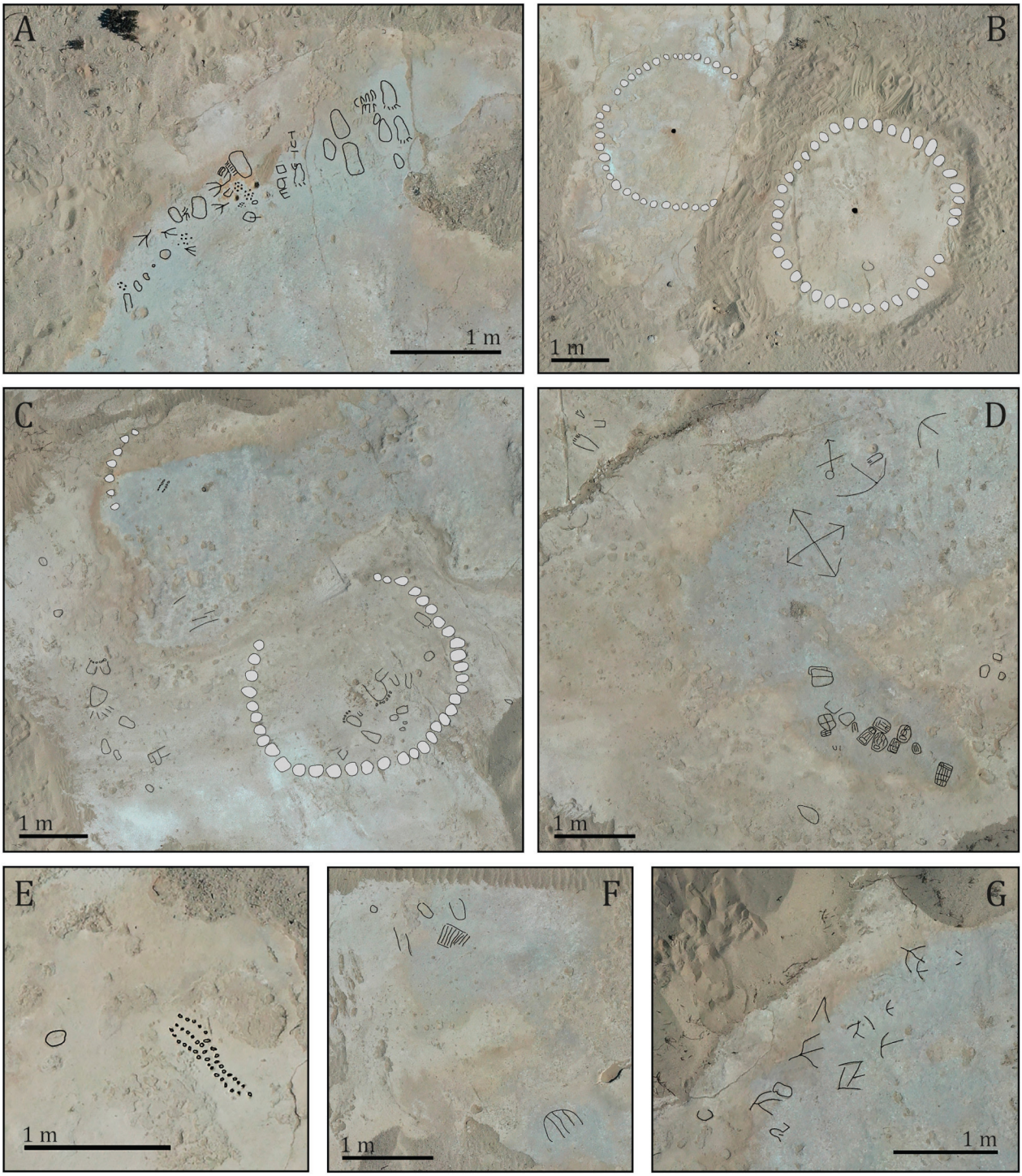


Figure 3. *Detail of the differentiated sectors in Figure 2. The motifs were digitally highlighted in the photograph.*

more than 50 m asl, so it is a relatively flat and open space, with high and extensive visibility, without immediate mountains or hills, dominated by a complex of active dunes that move due to the prevailing south-westerly winds (Fig. 2A). The site is situated almost at the centre of the peninsula, one kilometre from the coastline towards Caleta del Medio (SW) and almost the same distance from the beach of Bahía Maldonado (N) (Fig. 1).

The dune practically covers the site. It is only possible to recognise it in certain specific sectors where the wind has cleared the surface, exposing a floor of horizontal slabs of compact sand that forms a sedimentary rock of the sandstone type of medium to soft hardness that reaches a depth of about 50 cm (Fig. 2A). At other points the site has been cleared by human action, specifically due to the traffic of four-wheel drive vehicles that make their way to the beach and recently as a result of the construction with a backhoe of a dividing channel between private properties that destroyed an important part of the site. On this flat rock formation, the rock art motifs were created



Figure 4. *Some examples of the motifs represented on the site.*

horizontally, and the area of dispersion of the motifs is still uncertain because most of the terrain is covered by sand. Still, for the time being, the site is over 8000 m^2 in size.

The petroglyphs were made on the rock using engraving and incision techniques. There is no evidence of paint or other solutions for the aggregation of matter. The engravings were made with continuous and discontinuous impact.

The distribution of motifs on the rock platform is not homogeneous, and there are sectors with higher concentrations of motifs (Fig. 2B). In total, we have identified at least 130 motifs. These are mainly elements that we can associate with geometric shapes: lines, crosses, arrows, rectangles, circles and dots, among others (Fig. 3). Most of them were made independently, while others are grouped together to form composite figures (N=35), either by intersection, symmetry or inscription. In addition, other motifs can be identified as foot imprints, possibly human (N=7), having between two to six 'fingers' (Fig. 3A, C, D), and tridents, possibly bird feet (N=14) (Fig. 3A, D, G).

Among the composite motifs, one type stands out for its size and composition. It consists of two pairs of circular figures formed by a perimeter of smaller circles made by percussion in an area, one next to the other, leaving an opening, in the centre of which there is a formal hole about 10 cm deep and almost the same size as the perimeter circles (Figs 3B-C, 4A–B). One of these composite circles encloses other linear

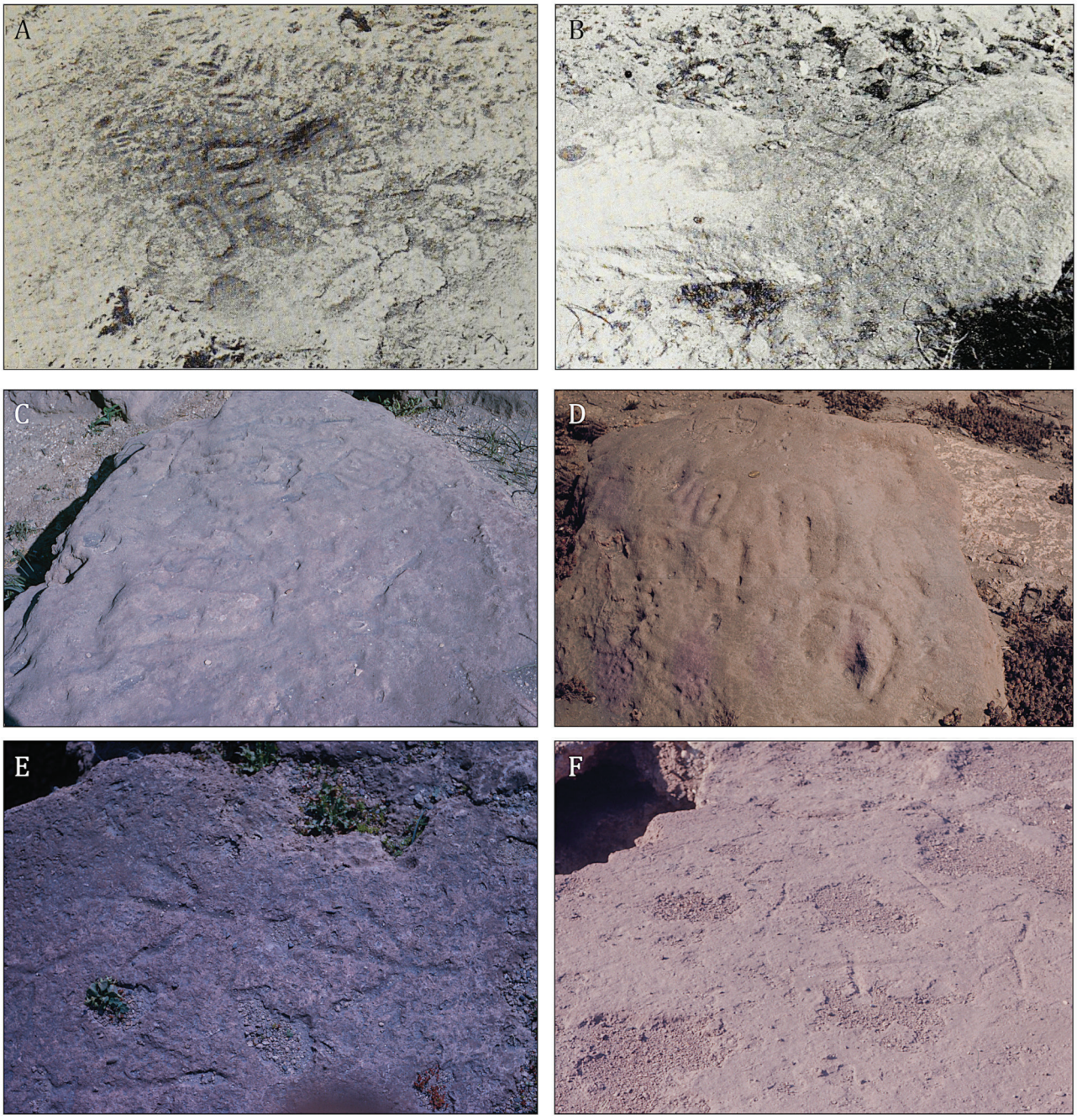


Figure 5. *Old photographs of the site of Las Losas at the port of Huasco: (A–B) Oswald Menghin (1964: 4.9, 4.10); (C–D) Jorge Iribarren (Archivo Documental of the Museo Arqueológico de La Serena).*

motifs, mainly abstract and human foot figures, an arrangement that appears not random but is part of the visual composition.

From the single site to the unconsidered previous cases

Despite the uniqueness of this rock art site, there is a reference to another similar one in the same region, also called Las Losas, which is located on the coast. It is situated immediately south of the town of Huasco and was completely destroyed some decades ago during the construction of the city's port facilities, making it virtually unknown in today's archaeological scene. Jorge Iribarren (1957, 1968a) was able to see it before its disappearance and states that the petroglyphs were incised on a horizontal platform of sedimentary calcareous rock with geometric and figurative motifs, the latter including vulvas and anthropomorphs. Years earlier (1956), Herbert Hornkohl took some photographs of the site and sent them to Oswald Menghin (1964), who compared these figures with others from Bolivia and south-central Chile, mainly due to the use of the engraving technique on horizontal supports of open-air sites. The motifs were distributed "on a flat granodiorite terrace extending along the coast at a height of 10 to 20 m asl" (Menghin 1964: 381; our translation); hence the appellation of Las Losas ('The Slabs' in English), as well as that of Bahía Salado.

In his article, Menghin (1964) reproduces some photographs where motifs of human feet, crosses, lines, rectangles and other geometric figures very similar to those of this new site can be recognised (Fig. 5: A–B). Years later, Iribarren took his own photographs at the site, now in colour, which unfortunately were never published. Nonetheless, we have recently found them in slide format in the Archive of the Museo Arqueológico de La Serena, where his documentary legacy is preserved (Fig. 5: C–F). The latter is a visual material of enormous archaeological value, as it helps to complement our fragmentary knowledge of this unknown rock art site, which has now completely disappeared. In addition to the above-mentioned motifs, these new missing images also show trident motifs similar to bird footprints, identical to those described for Bahía Salado.

Overall, it can be preliminarily concluded that the site of Las Losas of Bahía Salado is a local and coastal expression of few similar records at the regional level, which presents clear similarities to other sites further south in the country (Iribarren 1957; Menghin 1964; Niemeyer and Montané 1968). In terms of its manufacturing technique and iconography, it is more similar to the stylistic traditions of the semi-arid region and less to those of the north of Chile (Niemeyer 1955, 1977; Iribarren 1957, 1968a, 1973a; Mulet and Sanguinetti 1958; Mostny and Niemeyer 1983; Castillo 1985; Niemeyer and Ballereau 1996; Troncoso 2022). Despite this, for a better understanding of this site and its cultural correlations on a regional and macro-regional scale, further research is needed, not only of this rock art and its motifs but also of the rest of the archaeological sites to which they are associated in the surroundings of Bahía Salada, the challenge we are currently addressing in our investigation.

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RAR 42-1476

RAR REVIEW

Unveiling the tapestry of ancient's imaginings

A review of *Study of palaeoart of the world: a quest for understanding the evolution of human constructs of reality*.

2024. Edited by Giriraj Kumar. Pathak Publisher and Distributors, New Delhi, 400 pages, Hardcover, ISBN 978-93-91952-70-9.
This book review was first published in *Journal of Rock Art* (*JORA*) in Volume 3, Issue 2, 2024, pages 52–56. It is reprinted here with the kind permission of the publisher and authors.

By Xiang Wan and Keying Chen

This review consists in the written scholarship in honour of the Professor Robert G. Bednarik, which is published in *Study of palaeoart of the world: a quest for understanding the evolution of human constructs of reality* under the editorship of Giriraj Kumar. This collection of papers is not only an academic book, rather, it is an homage to one of the pioneering researchers in rock art, integrating various regions and literatures on palaeoart. The review also highlights the multidimensional coverage of the book, such as the achievements of Bednarik and his personal life, and his impact, if any, on the methods of rock art dating. Furthermore, it addresses the new geographical and thematic areas and approaches covered in the work, revealing the state of the art and technological advances in palaeoart studies. Moreover, the review illustrates why the work is crucial to both specialists and the general public in that it connects the audience to the past via the analysis of rock art as a pathway to the development of the mind of modern human beings. It concludes by commending the editors and contributors for their efforts towards the production of an informative and durable book about the legacy of rock art and all those who have striven to understand this art form throughout history.

The study of palaeoart throughout human history reveals the creative spirit of our ancestors and their quest to understand the world around them. *Study of palaeoart of the world: a quest for understanding the evolution of human constructs of reality*, edited by Giriraj Kumar, is not just a collection of academic essays; it is an homage to Robert G. Bednarik, a key figure in rock art research. This volume, published by Pathak Publisher and Distributors, offers a wealth of insights that collectively highlight the latest research on palaeoart globally, guiding readers through the evolution of human perceptions of reality.

The book cover undeniably captivates the viewer. The image of Bednarik, depicted as deeply engrossed in his research, effectively establishes the scholarly tone of the text. This edition is replete with insights from numerous experts, all contributing their distinct cultural perspectives to the discourse. For those interested in palaeoart, this volume is an indispensable resource.

Upon exploring into the work, the table of contents unveils an array of distinguished palaeoart scholars. Each scholar articulates fascinating viewpoints on the subject, which keeps the narrative invigorating. The book transitions seamlessly from the preface to the acknowledgments, with chapters meticulously structured. One can sense the collaborative effort that underpins this scholarly endeavour.

However, it is not solely about the diverse perspectives presented. Each argument carries its unique character and when synthesised, they significantly enrich our comprehension of the discipline. Moreover, the extensive research conducted is truly commendable; it fosters dialogue concerning the interplay between art and cognition. Therefore, it is certainly worthwhile to explore if you harbour curiosity about these intricate connections.

Chapter One of the book *Study of palaeoart of the world* is an enlightening overture in memory of a giant academic figure: Robert G. Bednarik. His contributions on rock art science were not only prolific, with 1480 publications in 32 languages, but also groundbreaking in that he introduced new dating methods and encouraged interdisciplinary debates. He excelled in various roles, including editor, organiser and teacher, all dedicated to uncovering humanity's oldest stories through artistic records. Personal testimonies and visuals included in the chapter bring forth a warm, intimate portrayal of a scholar for whom deciphering the artistic expressions of our ancient ancestors has been his life's mission, setting the compulsive tone for the ensuing scholarly palaeoart explorations that this book promises to offer.

In 'For my husband', Elfriede K. Bednarik makes a heartfelt, deeply personal contribution towards her husband, Robert G. Bednarik, a peek into the private life of this well-acclaimed palaeoart scholar. More than five decades into marriage, the testimony by Elfriede is a tale of adventure and commitment that

characterises life together, from continental Australia to indigenous cultures around the world. It is not only the story of companionship in academic quests, but also the review of a global community brought about by Robert's founding of IFRAO. The words of Elfriede, in all sincerity and simplicity of one who prefers to experience more than to write words, touchingly caught the essence of a life so enriched with love and shared passion. But this is a touching interlude in an academic volume, reminding us of the stories and passion that often lie beneath our scholarship.

Also personal is 'Robert G. Bednarik as I know him' by Giriraj Kumar, in which the well-known palaeoart scholar is described as a man of untiring focus and determination. The chapter captures the character of Bednarik through personal anecdotes and shared experiences that support his pioneering work in the field and his relentless pursuit of knowledge. The story of Bednarik's influence on the international view of rock art is well told, from the founding of IFRAO to his field-leading work in India. Kumar also relates Bednarik's humanitarian work, his resilience when confronted with adversity, and his selfless devotion to the documentation and preservation of palaeoart. Indeed, Chapter Three is more than a tribute; it is a testament to the life and legacy from a scholar who shaped the very fabric of the discipline of rock art.

Kalyan Kumar Chakravarty's chapter, 'Speaking after Robert G. Bednarik', is a trans-intellectual treatise summarising Bednarik's global observations and the large stir he has caused in the scientific study of rock art, especially in India. Chakravarty skilfully sums up Bednarik's lifelong research on the question of how to argue for the multilinear evolution of human language and cognition. He rejects the Eurocentric perspective and speaks for a varied approach globally informed, which reflects the Indian context relevantly. The most important local methodologies, the use of bio-neurological constants in understanding the minds of ancient individuals, and an urgent requirement are put forth for rigorous falsifiable scientific methodologies in the research of rock art. However, Chakravarty's synthesis does not just review Bednarik's legacy; rather, it extends by providing a roadmap for Indian rock art studies to meaningfully engage with global dialogues.

Ram Krishna's chapter, 'Robert G. Bednarik as a great teacher', stands as personal testimony to this famous scholar as a mentor. Krishna provides incidents that again point towards Bednarik's commitment, thoroughness, and how he shaped the professional and personal lives of his students. The story unfolds, revealing the attention to detail in research and teaching that Bednarik does, from initial interactions to arduous fieldwork. His teaching goes even further than the academic: great work ethic, respect for scientific communication, and understanding of how scientific study, environment and life are linked. This chapter is a modest tribute to a teacher whose commitment and sincerity set an example which is difficult to be equalled by any who have gone through his teaching.

Raoni Valle's chapter makes special mention of Robert G. Bednarik, whose work had a significant influence on the development of rock art studies in the world and, indirectly, on Brazil. His chapter underlines Bednarik's role in laying the groundwork for IFRAO and AURA, promoting rock art studies as an independent area of research. The innovative nature of his direct dating methods, his multidisciplinary approach and his promotion of indigenous knowledge all help to epistemologically decolonise the science of rock art studies. According to the account of Valle, Bednarik's unwavering dedication to scientific research and conservation estimated an influence on the lines of rock art research in Brazil and elsewhere.

Jesus E. Cabrera's chapter on Bednarik's contributions to Pampacolca, Peru, provides a true account of Bednarik's involvement with the region's painted stone tablets. His 2017 visit laid the groundwork for further investigation into the artefacts, which yielded a radiocarbon date that anchored the Formative Period chronologically. The chapter highlights Bednarik's role concerning these findings in bringing out their cultural significance and promoting further research. Cabrera also mentions that at Pampacolca, Bednarik was hailed, which explains his impact on the local people and within rock art research circles.

The following chapter saw Majeed Khan account for his joint work in the rock art of Saudi Arabia with Robert G. Bednarik. The chapter also placed in perspective the immense contribution Bednarik has made to research into the successful UNESCO World Heritage listing of sites in Jubbah, Shuwaymis and the Hima Cultural Area. Khan goes on to detail Bednarik's commitment, his vision, and the life-changing influences of their collaborative fieldwork. It further testifies to his commitment to the documentation and preservation of rock art, besides illustrating his work of promoting Saudi Arabia's palaeoart heritage for international recognition.

The contribution by Tang Huisheng represents the huge involvement of Robert G. Bednarik in the chronology of Chinese rock art by describing their own work together in laying a scientific framework for the subject. This chapter describes the introduction and application of the microerosion dating method, providing a new chronological framework of rock art sites in China. Tang also reflects on the passion Bednarik had for the scientific study of rock art, his influence in the establishment of the International Centre of Rock Art Dating, and his relentless pursuit for the advancement in the understanding of the antiquity and cultural significance of rock art.

Li Man presents reflections on Robert G. Bednarik's academic influence and methodology. She illustrates that with her personal experience of collaboration in fieldwork that involved the dating of rock art. The chapter epitomises Bednarik's scientific rigour, his valuable contributions to direct dating methods such

as microerosion analysis, and his impact upon Chinese rock art research. Li's narrative underscores Bednarik's commitment from his meticulous fieldwork in genuinely challenging environments to mentorship which has fostered a whole new generation of rock art researchers. This chapter is dedicated to Bednarik's career, to his lifetime commitment to scientific scholarship, and to the effect he has had on the professional and personal lives of his colleagues.

The following chapter by Gori-Tumi Echevarría-López and Rubén Urbizagástegui-Alvarado describes a scientometric review of the academic output produced by Robert G. Bednarik regarding the subject area of rock art. Based on the 914 documents published by Bednarik within the period from 1968 up to 2022, the authors evaluate his productivity, cooperation networks, thematic preferences and impact. This work shows Bednarik to be a highly prolific and influential voice, with a stable research trajectory and an enormous academic scope that goes way beyond rock art to themes like hominisation and neuroscience. Despite challenges with digital indexing and marginalisation, Bednarik's works stand out by the strict scientific approach and the dedication of this author to the development of international knowledge about palaeoart. This chapter quantifies Bednarik's scholarly achievements but also underlines his contribution to shaping scientific discourses on rock art.

These eleven chapters that comprise *Part I: Robert G. Bednarik and his contribution to rock art discipline* enable a multi-understanding approach for the great scholar's immense contribution to the rock art discipline. This section of the volume covers Bednarik's personal and professional background, the innovation of new methodologies in the dating of rock art, his founding of key scientific journals and organisations, starting with a comprehensive tribute in *Study of palaeoart of the world*. The chapters cover his fieldwork from around the world, his theoretical endeavours, and the mentorship which has formed the careers of many researchers through a suite of biographical accounts and scholarly reviews. The section is comprehensive, as it extends insight into the scientometric dimensions of Bednarik's enormous output; his work portrays him as a foundational figure in the discipline of rock art, inspiring and challenging common paradigms.

Part 2: Latest research on palaeoart of the world leaves from the foundational work done by Robert G. Bednarik to introduce the latest on contemporary palaeoart studies. This section includes a wide and diverse range of chapters, spanning different geographical regions to thematic approaches, presenting the latest developments, theoretical viewpoints and methodological innovations on the global study of ancient rock art.

In 'Evolution of the mind's eye', Dean Falk considers the selective underpinnings of artistic expression; namely why geometric figures predated representational ones by early hominins. This chapter discusses neurobiological underpinning for the perception of vision via evo-devo comparisons between humans and chimpanzees and through the development of drawing skills in children. Falk discusses how the primary visual cortex provides the foundations for simple visual perceptions and how these might be linked to the creation of early geometric art. It could be, in itself, a good explanation of the omnipresence of geometric patterns in palaeoart, namely that the roots of the 'artistic skills' are somehow connected to the course of visual processing and the developed cognitive abilities by weaving activities. Fascinating chapter while viewing the intersection of neuroscience, cognitive development and the evolution of artistic expression.

Robert Alexander Dielenberg, in the chapter entitled 'The evolution of hominin autopraxis: origins and effects', describes the cognitive evolution of hominins, focusing on the emergence and implications of autopraxis—a form of self-awareness that enables introspection and action. Dielenberg employs a three-tier model with sensory consciousness, body self-recognition and autopraxis to stipulate how these factors may have contributed to hominin divergence from other animals. The chapter hypothesises that in as much as heightened cognitive behavioural hybridisation, as in the case of tool-making and Acheulean culture, could have fostered parallel developments of autopraxis associated with symbolic behaviour. A new insight into the cognitive events which have marked hominin evolution and the place of self-awareness for the human beings.

Derek Hodgson, in the chapter entitled 'Neuroscience, visual imagery, rock art and the origins of writing', discusses the underlying cognitive processes necessary for the emergence of writing systems in view of findings in neuroscience coupled with archaeological evidence in early visual art work. It further demonstrates the role played by the visual cortex in the perception and simplification of visual information that appeared in rock art and related to the development of writing systems from pictographic to its abstract form. This chapter advances the hypothesis that the preference of the visual cortex for specific geometric patterns common in all writing systems could have been central in the discovery of writing. As Hodgson concludes, such practices as weaving might have given an essential impulse to writing inasmuch as they involved the visual system in pattern perception and in the creation of patterns. This chapter also reviews the deep cognitive and neural roots which have shaped the course of evolution of human symbolic systems from a new perspective.

In 'Perception, cognition and the semiotic affordance of patterns', Paul Bouissac challenges mainstream theories on rock art by advocating a closer look at the geometric signs that are so prolific in palaeoart. He is proposing an evolutionary approach in which the adaptive processing of natural patterns and their cognitive implications might be at the root of symbolic

communication. It is here that the chapter brings in the possibility of these geometric signs being early script forms, inscribing meanings and knowledge that had to be preserved. Bouissac invites a revision in assumptions relating to the origin of writing and the cognitive capacities of early humans by emphasising the importance of considering both figurative and geometric signs in understanding the archaeology of writing systems.

In the chapter entitled 'A review of the dating of oxalate biofilms associated with rock art', Alan Watchman explores in depth the rather complicated realm of dating the oxalate minerals within biofilms that are quite often found associated with rock art. He discusses the challenges to determine the age of carbon in these minerals, which pertain to: recognition of the micro-organisms involved and source of carbon, and carbon transfer processes to stable, oxalate-rich layers. The chapter then takes a review of early developments and the latest techniques used in dating carbon in oxalate, including applications of AMS radiocarbon dating, which have dramatically improved to allow dating with minuscule samples. Throughout, Watchman underlines the need for caution in the case of possible contamination and the complexity of the biofilm development processes through which the dating of sites can easily become flawed. The text draws on a large number of studies and case examples from across the world that provide a background of continual problems and the need for full understanding of biological and environmental activities involved in oxalate biofilm formation.

In 'Chemical analysis and three radiocarbon dates on Dominican Republic rock paintings', by Marvin W. Rowe, chapter 17 examines the Taínos' pictographs in the Dominican Republic. These Taínos were the island's original inhabitants from about 2000 years ago until after 1492. Since the mid-1970s, more than 400 sites have been recorded, provoking many thoughts about the rock art presented. In this regard, Rowe details the chemical analysis and radiocarbon dating of samples recovered from Cueva del Peñón, Cueva de Vidal, and Cueva de Las Maravillas. The purposes of this study were to contribute additional ^{14}C dates as well as determine the nature of pigments employed in the pictographs. Results of the analyses of five pictographs, three of which were radiocarbon dated, indicate ages of between 535±80 and 1390±85 years BP. The study contributes to the chronology and composition of the Taíno rock paintings that appear as a long tradition of pictograph creation spanning several centuries.

In 'Recent scientific research at the rock art sites in the southeast coastlands of China', Jin Anni and Chao Ge discuss the developments concerning the research into petroglyphs along the southeast coastline of China. Research, since the early observations of sites such as Jiangjunya in Jiangsu and Xianzitan in Fujian, has been essentially of a typological and stylistic nature. One of the most important events was the visit of the IFRAO team in 2014, which for the first time applied scientific methods of dating, such as microerosion analysis. The chapter outlines the geographical and historical context of the region, discusses the evolution of rock art science since the 1980s, and details recent scientific expeditions that gave a preliminary understanding of rock art in the area. These highlighted key sites include those in Xianju, Lianyungang, Zhangzhou and Zhuhai; hence, underlining diversity in motifs and the methods used while analysing. The authors underline the importance attached to the expedition in 2014, for it created a crucial moment in instilling a systematic approach to rock art research in China. Finally, to conclude this chapter, appreciate international colleagues whose effort marks this beginning. Future studies may successively unravel the developments of this ancient art form much more definitively.

In 'On the combination of science and phenomenology', Livio Dobrez examines how science and phenomenology are intertwined as part of rock art studies parameters. He presents a good and concise account of Husserl's phenomenology in which he establishes logical structure of understanding and intentionality. Then, Dobrez discusses three philosophies of science: Carnap's, Popper's and Kuhn's, each represented as singular insight into scientific inquiry. In reference to these schools of thought, he evaluates his academic career and details how they informed his conduct in studying rock art. The volume concludes with the methodological integration of scientific rigour and phenomenological depth as Dobrez focuses on the reception of rock art imagery through a biological and perceptual lens.

In 'A bology-oriented investigation of hand traces in rock art', Patricia Dobrez takes the position that hand stencils and prints form a special category within rock art that is different from other imagery. Analysing these trace images using a biology-oriented perspective that draws on cognitive science and neuroscience, Dobrez expands on the affordance logic of these trace images, focusing on how they are act—aspect over signature. The chapter examines the trans-culturally recognisable quality of hand traces, their role as an iconic exogram, and the ways in which they activate the proprioceptive awareness and mirror-neuronal activity of the observer. Treating hand images as remnants of actions provoking motor reactions, Dobrez argues that these images may have played an essential role in the emergence of primitive forms of communication and might bear a relation to the roots of language and written symbols. The chapter argues that hand stencils and prints should not be considered as merely passive representations but, rather, as dynamic imprints carrying the traces of an original act that calls for a response and perhaps facilitates communication across cultures and through time.

In the work 'India's contribution to the develop-

ment of rock art discipline', Giriraj Kumar looks at India's pivotal involvement in influencing the global scientific examination of rock art. The chapter outlines the progression of rock art research, starting from initial stylistic analyses up to the empirical methodologies promoted by the International Federation of Rock Art Organisations (IFRAO). India has been in the lead, with flagship projects like the Early Indian Petroglyphs Project, which attempted to date Indian rock art as perhaps the oldest known in the world. The EIP Project—a collaboration between the Rock Art Society of India (RASI) and the Australian Rock Art Research Association (AURA) that has contributed enormously by challenging the Eurocentric view on the origins of art and by reiterating the fact that rock art is a global phenomenon. Kumar further stresses that replication studies play a crucial role in understanding the cognitive and technological processes of early rock art. The findings from these studies elucidate the various tools, materials and competencies essential to early human populations, presenting an overview of their existence and cognitive development. Furthermore, this chapter highlights the pivotal contribution of India in the progression of rock art as a scholarly discipline via empirical investigation, questioning conventional paradigms and promoting a more comprehensive and worldwide understanding of human artistic endeavours and cultural legacy.

In 'Stone Age rock art and communication design', Hridayshri discusses Stone Age rock art and its exploration through the terms and concepts that qualify for promotion from that period of human expression to communication design. It underscores the intent application of design basics, principles and Gestalt theories entailed at the primitive level of artistic creations. It also highlights the potential of the visual language and effective story structuring within the artwork, as a communicative framework embodying the cognitive and sociocultural experiences of its creators. Reproduction of rock art from Chaturbhujnath Nala casts insight on the conceptional as well as technological abilities of its creators and underlines the importance of rock art analysis from a design perspective as a means of understanding its role in visual communication.

In his chapter 'Elephant call in the rock art of Algeria', Ahmed Achrati presents an innovative analysis of the arched lines illustrated surrounding elephants in the rock art of Algeria's Qsur Mountains, proposing that these lines signify the representation of stress vocalisations emitted by elephants. Achrati draws on the discourses of ethnography, cognitive studies and anthropology, taken together with the physical properties of sound waves, to make a case that these lines constitute one form of phonographic representations mode that might actually suture the experience of sound with its physical manifestation. This research explores the cultural connections between curved lines and auditory phenomena as manifested in diverse human expressions, ranging from historical inscriptions to contemporary experimental approaches. It argues that the curved lines found in rock art serve as a symbolic depiction of the vocalisations produced by elephants, thereby offering valuable insight into the cognitive and empathetic reactions of the artists from antiquity.

In 'Hand and foot prints at Qiusang in Tibet: a review,' Tang Huisheng and Shargan Wangdue present the results from the discovery of ancient human hand and footprints on travertine in Qiusang Village, Tibet, and a scholarly debate about their dating and interpretation. The authors review several age estimates ranging from 7–220 ka and place particular emphasis on a 2021 *Science Bulletin* article publishing these results, which reported that the prints represent the world's earliest parietal art, and which have sparked controversy together with the corresponding media hype ever since. In addition, they test the reliability of uranium-series dating and then discuss its consequences for the origins of rock art and human symbolic thinking. The chapter allows to present the cultural and archaeological background of the place, local legends, and problems of their interpretation among diametrically opposed proofs and theories.

In 'On the relationship of the squatting-figure rock art in Guangxi and Yunnan, China', Xiao Bo, Che Jing and Cao Yujie examine the similarities and thus probable cultural inspirations in ancient rock art—as found in two Chinese provinces. The authors analyse the dating techniques and stylistic features of the squatting-figure rock art and find that the art in Yunnan dates back 3500–2500 years ago and that in Guangxi it dates back 2500–1800 years ago. The authors make a discussion of common characteristics set in the art, such as the used red pigments and cultural implication of the motives, with the assumption of possible exchanges or shared influences of the creators of this art. Further, the chapter is a critical review of research related to these rock art sites and presents cultural interactions of ancient times.

The account of the discovery was described by Charles W. Helm and colleagues in 'Rescuing ancient palaeoart in coastal South Africa', of 'ammoglyphs', ancient designs painstakingly incised in the sand by early humans and now irreversibly impressed in the rock formations of southern South Africa's Cape south coast. Such designs, yielding to erosion and the vicissitudes of nature, represent a uniquely fragile form of palaeoart. The authors describe two marvellous ammoglyphs as well as their discovery, which may be close to 130,000 years old, and in so doing, they associate them with the Middle Stone Age. Such discoveries go deeper in our understanding of early artistic expressions of humans and provide invaluable insight into the cognitive development and cultural practices of early *Homo sapiens*. Those rescued specimens now are preserved within the new Blombos Museum of Archaeology, ensuring they remain safe

and available for future research and interpretation.

In the chapter entitled 'Petroglyphs on Murujuga, Western Australia – unique, endangered and disappearing – the R. G. Bednarik legacy for hope', John L. Black and Robin H. Chapple discuss the various problems besetting the ancient petroglyphs on Murujuga in Western Australia. These extremely valuable palaeoart creations, which may well be from a time as early as 45,000 to 65,000 years, are now threatened by industrial activities, acid rain, and the dissolution of ferromanganese coatings. The contributions of Robert G. Bednarik in this regard emerge pre-eminently where he dedicated his life to the documentation of these petroglyphs, by studying the chemical mechanisms responsible for their deterioration and by championing the withdrawal of industrial activities from the region. Despite numerous impediments faced, efforts at documentation led by Bednarik have significantly increased awareness and promoted research aimed at the protection of these cultural treasures for the future.

The final chapter, 'Quantifying the sustainable development of rock art heritage' by Ram Krishna, highlights the critical need to manage and preserve India's diverse rock art heritage to foster sustainable socioeconomic growth. It underscores the necessity for a standardised and comprehensive approach to handling these heritage sites, especially considering the irreversible harm that can arise from misguided decisions. The chapter introduces a dynamic model for sustainable development that takes into account factors like culture, tourism and conservation efforts. This model is crafted to be flexible, accommodating the distinct characteristics and challenges of each site, including issues like vandalism and environmental risks. Experts in the field have endorsed the model, indicating its potential to assist policymakers and managers in making well-informed choices regarding resource distribution and heritage site oversight. The author concludes that this model can facilitate a careful balance between promoting cultural heritage and safeguarding it for future generations.

In conclusion, *Study of palaeoart of the world: a quest for understanding the evolution of human constructs of reality* represents a vital addition to the field of palaeoart. It pays tribute to the remarkable contributions of Professor Robert G. Bednarik and encourages future inquiries, inspiring a new wave of scholars to delve into the rich tapestry of human artistic expression. The comprehensive analysis of rock art from various cultures and regions, coupled with latest scientific approaches, makes this volume an essential resource for academics, researchers and enthusiasts.

In examining the corpus of knowledge presented within this volume, it becomes apparent that the study of palaeoart transcends mere scholarly pursuit; rather, it constitutes an in-depth exploration of human essence. Artistic expression serves as a conduit through which we may glean insights into the cognitive processes, belief systems and lived experiences of our predecessors, thereby establishing a substantive connection to our collective past. This text stands as a testament to the enduring significance of rock art, functioning as an aperture into the evolution of human cognition and underscoring the importance of collaborative scholarly investigation.

A hearty round of applause to the editor and contributors of this volume for their hard work, after many months together making it was both instructive and comprehensive in coverage. *Study of palaeoart of the world: a quest for understanding the evolution of human constructs of reality* isn't just exciting reading; it's an important project which will lead and influence palaeoart research for the future many years that lie ahead.

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Kunlun in Qinghai's prehistoric art

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According to statistics, there are now more than 100,000 painted pottery finds of the Majiayao Culture circulating in the world. Behind such a large number of cultural products, there must be profound cultural thoughts and cultural designs, which is the Kunlun myth system. Only the Kunlun myth system can accommodate this river of painted pottery, and similarly, only this river of the painted pottery can fill every space of the Kunlun myth system. The Kunlun myth is the voice of Majiayao painted pottery, and Majiayao painted pottery is the image of the Kunlun myth. Only by combining the two can the sound and visual images of the ancient Qinghai spiritual civilisation be presented, restoring the unique and complete

narrative of ancient Qinghai culture.

Types and chronology of vehicle petroglyphs on the Inner Mongolia Plateau

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Vehicle petroglyphs represent a significant category of rock art on the Inner Mongolia Plateau. By employing the shaft of the vehicles as a 'typological marker' and the wheels and draft animals as 'artefact combinations', this study investigates the chronological sequence of vehicle petroglyphs through archaeological typology and comparative analysis with ancient vehicle forms. Discussions on the origin of chariots, the domestication of horses, and the archaeological findings of vehicles provide valuable references for understanding the forms and dating of vehicle petroglyphs. Therefore, vehicle petroglyphs are one of the rock art types that can be relatively accurately dated. This study concludes that the majority of single-shaft (the 'yuan') vehicle petroglyphs on the Inner Mongolia Plateau date from the Late Shang to the Spring and Autumn periods. The double-shaft vehicle petroglyphs are later than the single-shaft ones and may date from the Han Dynasty or later. Additionally, the vehicles depicted in the petroglyphs served not only as means of transportation but also for hunting and warfare, and they may have had ritualistic or ceremonial significance.

A study on the archaeological chronology and iconographic types of human-faces petroglyphs in the Xiliao River Basin

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Utilising existing archaeological surveys and research findings, this study organises and analyses the distribution and image types of human-faces petroglyphs in the Xiliao River Basin, using the known archaeological periods as a reference system. By integrating the structural characteristics and stylistic features of the human-faces petroglyphs images with the relevance to archaeological remains, and employing a comprehensive comparative method using archaeological materials and iconography, this study conducts a horizontal comparative study on the main types of archaeological materials and human-faces petroglyphs in the Xiliao River Basin. It establishes a preliminary chronological scale, organises the main stylistic types for each period, and attempts to establish a chronological and spatial framework for the development and evolution of human-faces petroglyphs from the Neolithic period to the historical period in the Xiliao River Basin, conducting indirect periodisation and classification research.

Object image and connotation: ethnological research in the Wanshan rock art in Kaohsiung City, Taiwan, China

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The Wanshan rock art located in Kaohsiung, Taiwan, China, is the only rock art site discovered in the Taiwan region, holding significant value within the Chinese and Austronesian rock art systems. Based on the investigation of the traditional cultural beliefs of the indigenous Rukai and Paiwan tribes in the area where the Wanshan rock art is situated, this study interprets the style and meaning of the Wanshan rock art images. It focuses on exploring the commonalities between wood carvings, pottery and the images of Wanshan rock art; and conducts an investigation and preliminary study on the coexistence of megalithic culture and Wanshan rock art. By examining the ethnic cultural implications carried by the 'objects' in the area of Wanshan rock art and the megalithic remains, this study deepens the understanding and knowledge of Wanshan rock art.

A study on the cultural memes identification in the human-faced images of ancient rock art from the Baicha River Basin, China

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Baicha River Basin is the earliest area in which ancient rock art were discovered in Western Liaohe region of China. Rock art was discovered one after another from 1984 to 2022. However, the basic historical materials of human-shaped rock art have not been systematically sorted out. Based on the historical data of human-faced rock art in two papers and five monographs, 18 rock art motifs and 26 human-faced images from the Baicha River Basin were selected and utilised to decode explicit cultural memes according to Cultural Textual Theory, encompassing 5 environmental attributes and 6 morphological features. The 26 images alongside the Baicha River are mainly

distributed in 5 places such as Qianshan Village and Dahelong Village of Wanheyong Town in Keshiketeng Banner, Inner Mongolia Autonomous Region, China. 65.4% of human-face images are distributed in the left bank of Baicha River. 69.2% of human-face images are less than 10 metres from the ground. And 65.4% of human-face images are less than 350 metres from Baicha River. 92.3% of the images with eyes are the key expression content. 80.7% of them have no beard, 76.9% have cheeks, 61.5% have headdress, 61.5% have a mouth and 57.6% have a nose.

Study on the dating of human-face petroglyphs 'located on adjacent rock surfaces' in the Xiliao River and Amur River Basins

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The human-face petroglyphs 'located on adjacent rock faces' is a unique type of human-face petroglyphs, which is distributed in the Xiliao River Basin of Inner Mongolia and the Amur River Basin of Russia. From their distribution characteristics, production techniques and type characteristics, there is a close relationship among these human-face petroglyphs. The human-face petroglyphs discovered in the Xiliao River Basin exhibit a remarkable chronological continuity, with their production chronology traceable to the Baiyin Changhan phase of the Xinglongwa Culture, which dates back approximately 7000 years BP. This lineage extends through the early Zhaobaogou Culture and Hongshan Culture and continued until the late Hongshan Culture. In the Far East region of Russia, the human-face petroglyphs first appeared during the Maleshevo Culture period around 6000 years BP. Following an incubation phase within the Maleshevo Culture context, developed greatly in the subsequent period of the Voznesenskoye Culture. A series of studies suggests that this type of human-face petroglyphs likely spread from the Xiliao River Basin in Inner Mongolia to the Amur River Basin in Russia.

Book review: '*Helan Mountain rock art: a hundred themes*'

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Since the discovery of the Helan Mountain rock art, a vast number of papers and monographs have been published on its investigation, research, conservation and development. However, most existing works have focused narrowly on field surveys, specific rock art sites, or particular thematic categories, while others primarily serve as popular science introductions. A comprehensive, systematic study synthesising the rock art's broader cultural, historical and archaeological significance has remained lacking.

The book *Helan Mountain rock art: a hundred themes* (*Helanshan yanhua bai ti*), authored by He Jide and edited by Ding Yufang, addresses this gap by presenting a structured examination through 100 key questions. It systematically covers four major aspects: fundamental knowledge of rock art, academic research methodologies, conservation practices and sustainable tourism development. Beyond its role as a popular science resource, this volume serves as an essential introductory guide for professionals engaged in rock art preservation and research, significantly contributing to the dissemination and advancement of rock art studies.

Cupules in Cuba: a review

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Cupules are a form of rock art found in most parts of the world, including the Caribbean islands. Those of Cuba have rarely been considered a distinctive phenomenon. This article attempts to provide a generic summary of Cuban cupules and similar but larger mortar rocks, including a brief history of their discovery. Previously offered interpretations are reviewed, and descriptions of the thirty-four sites of

their occurrence are presented. Small cupules tend to be steep-walled and probably involved indirect percussion or drilling, whereas large cupules suggest creation by direct percussion. Frequently groups of small cupules occur together with mortars on portable rock slabs but are more recent than the mortars. This consistency seems to indicate a quite specific cultural behaviour. Nevertheless, the production traces of the cupules are generally consistent with cupules on relatively soft rock elsewhere on Earth.

The cliff paintings of Pha Taem, Luang Prabang, Lao PDR

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Pha Taem in Luang Prabang Province, northern Laos, is a cliff face overlooking the Ou River with over 300 red pictograms, mostly handprints, anthropomorphs, zoomorphs, and others interpreted as 'hunting scenes' and 'boats'. One local interpretation of the site is as a commemorative scene for hunting animals, which took place on the opposite riverbank. Interestingly, the motifs depicted on the wall have similarities with cliff paintings at the Pak Ou Caves some 70 km downstream. The physical connection of the two sites along the same river raises the possibility of locating more rock art sites along the Mekong and the Ou River and underscores the role of rivers as lines of communication in this mountainous environment.

RECENT BOOKS OF INTEREST

Les Cahiers de l'AARS, No. 25, edited by the Director of Publication, JEAN-LOÏC LE QUELLEC. 2025. Association des Amies de l'Art Rupestre Saharien, Canéjan, France. 228 pages, softcover, illustrated in colour and monochrome. Comprises 12 papers in French and 2 in English.

Between the rock and the sky. Rock art of Canaima National Park, Venezuela, by JOSÉ MIGUEL PÉREZ GÓMEZ and ROGER SWIDOROWICZ. 2025. Fundación Manoa, Bubok Publishing S. L., Venezuela, Foreword by Prof. Robert G. Bednarik. 324 pages, 23×29 cm, hardcover, extensively illustrated in colour (161 images, mostly full page), comprehensive bibliography, ISBN 978-84-685-8650-2.

RECENT PAPERS OF INTEREST

Posthuman archaeology and rock art, by JOSÉ CHESSIL DOHVEHNAIN MARTÍNEZ-MORENO. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 3, pp. 353–372.

Angara style rock art: the evolution of a regional emblematic and syncretic style, by LYNDA D. McNEIL. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 3, pp. 477–494.

Wounded animals and where to find them. The symbolism of hunting in Palaeolithic art, by OLIVIA RIVERO, MIGUEL GARCÍA-BUSTOS and GEORGES SAUVET. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 3, pp. 511–529.

Figurative representations in the north European Neolithic—are they there? by RUNE IVERSEN, VALESKA BECKER and REBECCA BRISTOW. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 4, pp. 601–619.

Dances with zigzags in Toro Muerto, Peru: geometric petroglyphs as (possible) embodiments of songs, by ANDRZEY ROZWADOWSKI and JANUSZ Z. WOŁOSZYN. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 4, pp. 671–691.

The beginning of time, by KARENLEIGH A. OVERMANN. 2024. *Cambridge Archaeological Journal*, Volume 34, Number 4, pp. 693–709.

ORIENTATION

Towards a scientific paradigm: multidisciplinary rock art research in China

By TANG LONGHAO

As we know, since the last decade of the 20th century, the International Federation of Rock Art Organisations (IFRAO), under the leadership of Robert G. Bednarik, has sought to create a discipline rendering the general endeavour of rock art research into a scientific pursuit. Their practices include setting international research standards, determining an ethical code, establishing uniform terminology, and, most importantly, initiating a scientific methodology. The progress made in rock art research in the past 30 years exceeds that of the previous 200 years. A variety of scientific methods have been applied in this discipline. While much of the work has focused on the antiquity of rock art, issues such as the techniques used to produce it have also received attention. In addition, nano-stratification of paints and mineral accretions also contributed to the scientific identification of rock art sequences. Field microscopy also began to develop for reasons such as dating, petrography and technological analyses. Experimental studies of rock art were also attempted, although they remain still in their infancy. The application of statistical methods is also becoming more and more mature. Not least of all, taphonomic logic has advanced, which was central to the development of rock art as a science. Therefore, today, the science of rock art is essentially different from the traditional approaches.

Following this trend, Chinese rock art research has also begun to move towards a scientific discipline since the 21st century. But before that, as in other areas of the world, rock art research in China was conducted in an empirical or humanistic fashion and lacked a formal discipline, universal methodologies, terminology and corresponding international standards, although there were long-term research practices. Most empirical or humanistic studies focused on interpreting rock art, such as what it reminded them of and how similar it seemed to something else they had seen. Even today, this type of study remains popular. However, we must emphasise that such 'studies' reflect people's self-awareness of rock art and are not falsifiable, so they cannot be called proper science, although they are valuable. In fact, the current rock art research in China is in an era where two paradigms coexist.

From 5th to 8th April 2024, a seminar with the theme of 'Chinese Rock Art Research Paradigm in a Multidisciplinary Context' was held in Shijiazhuang City, Hebei Province, China. This seminar was hosted by the School of History and Culture of Hebei Normal University and organised by the International Centre of Rock Art Dating at Hebei Normal University and the Archaeology Department of the School of History and Culture of Hebei Normal University. A total of more than 60 scholars participated in this seminar. They came from different universities and research institutes, including the International Federation of Rock Art Organisations, Indian Rock Art Association, Institute of Vertebrate Palaeontology and Palaeoanthropology of Chinese Academy of Sciences, Minzu University of China, Nanjing University, Nanjing Normal University, Xi'an Jiaotong University, Northwest University, Tibet University, Hebei Normal University, Chongqing Institute of Cultural Relics and Archaeology, Tibet Autonomous Region Institute of Cultural Relics Protection, Qinghai Provincial Institute of Cultural Relics and Archaeology etc.

During the seminar, scholars discussed the latest progress in Chinese rock art research and the importance of multidisciplinary cooperation. Among them, 22 scholars made presentations, which focused on three parts: theories and methods of rock art research, new developments in scientific rock art research, and new advances in humanistic rock art research. These presentations show that rock art research in China is actively accepting contributions from other scientific disciplines. At the same time, a variety of scientific methods have been more widely used in the recording, dating and conservation of rock art than before. Some scholars have also conducted cross-regional comparisons of rock paintings and tried to interpret them from different perspectives. This means that traditional research approaches have not lost their vitality. In the background of the continuous emergence of new discoveries, scholars also reviewed the development history of rock art research and discussed how we should study rock art scientifically and how to strengthen the connection between rock art and other disciplines.

1. Theories and methods of rock art research

Eight scholars' presentations centred on the theories and methods of rock art research. They reviewed, to varying degrees, the attention paid to rock art by early scholars and, based on this, discussed some methodological and epistemological issues, such as

how we should analyse, conserve and utilise rock art scientifically and how to improve our level of rock art research from a multidisciplinary perspective.

Robert G. Bednarik pointed out that this seminar raises fundamental questions about how we conduct our research. He believes that applying multidisciplinary methods is to make rock art research more scientific than humanistic. Regarding the questions that scientific rock art research should pay attention to, he emphasised five aspects. First, it is necessary to discriminate between natural rock markings and those made intentionally by humans. This is obviously fundamental to scientific rock art research. In fact, until we are sufficiently certain that a particular rock marking belongs to what we define as rock art, there can be no effective analysis of this phenomenon. After all, there is no value in investigating the style, significance and archaeological age of a natural marking. Second, it is also very important to determine the raw materials and technologies of rock art because neglecting their technology, particularly of petroglyphs, can easily lead to significant misinformation in terminology and a failure to appreciate the significant interplay between technology, taphonomy, recording and interpretation. Third, we need to record rock art sites using currently available methods and technologies to create a visual register of those aspects of the art that are deemed 'important' and a database for rock art conservation and management. Fourth, we should use various scientific methods to estimate the age of rock paintings. This is a way to relate rock art to archaeology and is also basic for interpreting rock art. Fifth, we should pay more attention to the conservation of rock art and develop the science of conservation. Rock art is a major resource for palaeoart studies, with the ultimate goal of determining the origins of human constructs of reality. Therefore, preserving and curating this irreplaceable resource is necessary, and we should devote more attention to this field than before. Bednarik believes that we can only credibly interpret some aspects of rock art when we have assembled exhaustive rock art science. He also listed some disciplines that could be included in a multidisciplinary approach. These disciplines include Geology, Geomorphology, Tribology, Forensics, Semiotics, Epigraphy and Archaeology.

Giriraj Kumar pointed out that the physical evolution of hominins might have occurred in Africa, but Asia appears to have been the hub of cognitive and cultural development. Now is a proper time to explore and discover more such evidence to establish the missing links and to build the story of human cognitive and cultural evolution on solid evidence of palaeoart and its scientific study. To this end, he briefly presented the vision, plan, and strategy to achieve that goal. Regarding the search for rock paintings, he believes that the potential areas will be where there is already evidence of hominin presence in the form of stone artefacts and fossils. The involvement of geologists, experts in the study of palaeoenvironment and early petroglyphs, microscopy, geochemistry, and such scientists from various disciplines from different parts of the world is necessary. He also stressed the importance of conceiving a multidisciplinary project after the discovery of a genuine and proper early rock art site. It is also important to secure sufficient funds to execute the project, simultaneously write a report of the work being carried out and get it published in the established international journals of science and technology. To understand the early rock art site as a dynamic entity of cultural activities and their development over time, he believes that scholars need to study the processes involved in the preproduction and production of rock art. Thus, the study of the taphonomy of the site and the evidence of the ongoing cultural phenomenon at the site and in the surrounding region is necessary, as well as the experimental study of the production of rock art on similar hard rock. Understanding the processes of the creative traditions of the communities practising rock art and/or associated with such activities is also needed. Efforts should also be put into obtaining direct dates for rock art by different methods and techniques. He recalled that many expeditions have been successfully carried out to obtain absolute dates for Chinese petroglyphs, with the leadership of Prof. Robert G. Bednarik (Australia) and Prof. Tang Huisheng (China) in the last decade of 2014–2024. It resulted in providing more than 200 microerosion dates for petroglyphs in China. He believes now is the right time to explore the possibilities of working on a high-profile, multidisciplinary, international project in China, which has been a neglected area so far. China, India and Australia can form a dedicated and involved team to work on the early rock art of Asia, especially in China, better to understand the evolution of human constructs of reality.

Li Yongxian put forward his own views on the 'correlation' between rock art research and other disciplines. He pointed out that the history of Chinese rock art research is not very long, but there has been significant progress in field discoveries, survey scope, published results and the growth of the research team. The conservation of rock art has also made corresponding progress. However, there are still some 'bottlenecks' in the current Chinese rock art research. For example, the correlation between rock art research and related disciplines is still insufficient, and rock art dating methods or technologies have not yet achieved key breakthroughs. These may affect the deepening of rock art research. He believes that there is insufficient interaction between rock art research and related disciplines such as history, archaeology, ethnology, art history, museology and cultural relics conservation. The study of rock art has also not received corresponding attention, which is related to some of its own shortcomings. For example, the publication of data is not standardised enough, the confidence in its dating conclusions as historical cultural relics is not high, and the rock art is difficult to correlate with the

surrounding archaeological culture etc. He suggested that research on Chinese rock art should pay attention to improving the correlation with related historical disciplines. To put it simply, it is important to improve the writing standards for rock art field investigation reports and publish the original data as soon as possible to make it available for researchers from other disciplines. Second, attention should be paid to the study of the correlation between rock art and other ancient cultural records of the same period and region. In addition, ethnographic investigation is also very important, which makes rock art significant to the local history. Third, we should strengthen basic research on rock art. In addition to scientific investigation and data publication, this aspect also includes strengthening rock art conservation technology, understanding rock art production technology, establishing rock art archives etc. Fourth, cooperation in natural science and technology should be introduced to tackle key problems, and progress must be made in the dating of rock art remains. Fifth, promote the social display and publicity of rock art, activate the historical scenes reflected in rock art, enhance the historical credibility, and establish the cultural connection between rock art and modern society.

Gao Xing discussed some relevant issues regarding Chinese Palaeolithic rock art. Taking rock art records such as the Wanrendong in Yunnan and the Huiqianyan in Chongqing as examples, he analysed the dating, artistic creation, religious origin, production and social life, environmental background and resource status of Chinese Palaeolithic rock art. He also divided the dating of rock art into five levels. The first level is to date rock art directly. The second level is to indirectly date the rock art. The third level is correlation analysis. The fourth level is to use comparative methods to infer the age of rock paintings. The fifth level is analysis using evidence from zooarchaeology and biological anthropology.

Xu Feng reviewed the rock art research from the perspective of cognitive archaeology. He sorted out the distribution, content and interpretation history of rock art based on cases from different regions of the world. Xu pointed out that the choice of where to make rock paintings is a cognitive choice, which largely depends on the spiritual needs of the early ancestors. He also believes that motifs can reflect people's cognitive abilities and spiritual meanings. For example, the evolution of the cognitive abilities of ancestors can be reflected through the characteristics, combination and narrative of motifs. He also introduced different theories through which previous scholars have interpreted the rock paintings. He pointed out that the process of interpreting rock art is exploring how ancient people thought. These theories may not be perfect and have shortcomings and defects of one kind or another, but they represent the efforts of generations of scholars. They are also providing the basis and motivation for new interpretations. He put forward his views on conducting cognitive archaeological research on rock paintings. He believes that mid-range theory plays an indispensable role. Without mid-range theory, cognitive archaeology is little more than speculation. In order to better study rock paintings, he gave four suggestions. First, new findings should be updated in a timely manner based on the existing data. Second, carry out the work of sorting out the academic history of rock art research, and inherit and innovate based on criticism. Third, carry out comparative research. Fourth, international research standards, global rock art terminology, operational academic norms, and scientific research methods should be adopted to establish a rock art research system. At the same time, specific rock art analysis methods should also be considered, including colour calibration, microscopy, microstratigraphy etc.

Yang Huiling discussed the conservation and inheritance of Chinese rock paintings from the perspective of 'holism'. She pointed out that China has made active attempts in recent years to promote the construction of rock art conservation regulations, deepen theoretical research, broaden the scope of utilisation, and increase publicity and display. Rock paintings are also being developed as a tourist resource in Ningxia, Guangxi and other places. To a certain extent, these efforts have established several special digital conservation projects, developed display platforms, and enabled the public to access rock art information through digital communication. For future development, she suggested that we think from the perspective of 'holism' and use advanced digital technology to carry out data conversations about endangered rock paintings. We should also rely on new media technology to disseminate rock art information from multiple angles to improve our current rock art conservation and inheritance practice.

Huang Yaqi took the Tongbaishan rock paintings in Hubei as an example to discuss the activation design of the landscape of rock art sites. She found that Tongbaishan rock paintings have extremely high pre-Historic and unique regional cultural values and are of great significance for tracing the origin of human culture. However, their survival situation is worrying. Therefore, she proposed three paths to promote the conservation of rock art cultural heritage: establishing a site resource conservation system, extracting rock art cultural symbols, and creating a 'corridor model' for the Tongbaishan rock art heritage site.

2. New developments in scientific rock art research

Scientific rock art research is different from other forms of rock art studies. Humans lack access to objective reality, so proper science offers a framework of knowledge claims that need to be testable by refutation. This means that a proposition must be presented so that the conditions under which it may be refuted are either evident or they can be formulated. A proposition that cannot be refuted outside the brain of the

proposer is not scientific. In this seminar, four scholars applied natural science techniques to rock paintings and made contributions to the dating, recording, conservation and interpretation of rock art.

Tang Huisheng presented how they used the uranium series method to date the rock paintings in Baiyunwan, Yunnan. He reported that in 2020, the International Centre of Rock Art Dating at Hebei Normal University, the Cultural Relics Management Office of Diqing Tibetan Autonomous Prefecture of Yunnan Province, the Diqing Cultural Relics Protection Society of Yunnan Province and other institutions formed a joint rock art expedition team and conducted a field investigation of the Baiyunwan rock art site. More than ten effective uranium series dating samples have been obtained through that. This provides a scientific basis for confirming the age of Baiyunwan rock paintings. These dating samples further promote our understanding of rock art in this area and indicate that the hunting motifs in the Baiyunwan rock art may be the earliest among the currently known archaeological materials in China. In particular, Tang stressed that Palaeolithic uranium dating must be used carefully because the older the date, the greater the error. Hence, it is better to interact with carbon 14, or other technological dating means to achieve mutual verification. Tang specifically mentioned that in the past decade, meaningful results have been achieved in microerosion dating of more than 20 petroglyph sites in China through cooperation with scholars from Australia and India. Combined with ancient Chinese documents, these dating results have been used in the interpretation of early Chinese myths and history. The establishment of the International Centre of Rock Art Dating at Hebei Normal University is also one of the results of this international cooperation. This centre currently plays a very important role in dating Chinese petroglyphs. Tang said that this mode of international cooperation will continue, and the centre will also establish a microerosion dating database to serve the microerosion dating needs of the whole world.

Zhang Haiwei discussed the application of uranium series dating methods in the study of rock art. He introduced the basic principles and applications of isotope laboratories and uranium series dating methods and pointed out that this method has been widely used in archaeological research. In the study of rock art, uranium series dating has been applied to the Baiyunwan and Wanrendong rock art sites. This is significant to the study of Jinshajiang rock art and lays the foundation for the dating of subsequent rock art research.

Yin Jie discussed the application of multi-view image three-dimensional reconstruction technology in rock art. She proposed that multi-view image three-dimensional reconstruction is a technology for three-dimensional model reconstruction based on digital images. It has emerged and been widely used in the field of archaeology and cultural heritage in recent years and has also brought new opportunities to the conservation and research of rock art. Taking the Jiangjunya rock art site as an example, she discussed using Agisoft Metashape software to reconstruct the rock art in three dimensions. After practice, she believes that the multi-view image 3D modelling technology is easy to operate, convenient and fast, and the final 3D models, orthophotos and 2D line drawings can achieve the expected results. This proves that this technology has high feasibility and applicability for digital tasks such as 3D model reconstruction of rock art.

3. New advances in humanistic rock art research

In this seminar, ten scholars used humanistic approaches to discuss rock art in different regions. Here, humanistic methods mainly refer to traditional archaeological, ethnological or art-historical methods. Such studies tend to compare rock art styles and explore their meanings. Since these studies are not testable by refutation, they are somewhat non-scientific. However, this does not mean that humanistic or empirical research has no value. These practices have greatly benefited the discipline, such as making rock art more interesting and attracting public attention. They also assisted in the appreciation and preservation of rock art. In addition, some comparative studies are based on data with obvious similarities, which help us understand the relationships among ancient groups.

Wei Jian discussed the type and age of rock paintings in the Dahuizhe area of the Yellow River. He used archaeological typology to explore the distribution area and motifs of rock art in Yinshan, Helanshan and Zhuozishan, and speculated on the livelihood patterns of the residents who produced these petroglyphs. He found that some rock art with human face motifs like 'Sun God' and a small number of animal petroglyphs with deep marks were likely to be products with profound religious worship implications. Other rock art with animal themes should have been produced by people living in the northern steppe from the Shang and Zhou dynasties to the Xiongnu period. He believed that they depicted the people's daily life at that time and expressed their desire for a prosperous life.

Gao Qi'an discussed the rock art in Gansu. He found that Gansu rock paintings are mostly distributed along the Silk Road, and there are various archaeological cultures distributed at or near the location of the rock paintings, such as Majiayao Culture, Qijia Culture, Shajing Culture, Siba Culture, Huoshaogou Culture, and Xichengyi Culture etc. In some cases, tools unearthed from sites and tombs appear in rock art. Therefore, he believes that many of the rock art producers may be the owners of these nearby sites and tombs. These also give Gansu rock art different research methods from rock art in other regions.

Bai Jiujiang preliminary analysed the 'vertical-eye rock art' in Bayang. He compared the vertical eye motifs in the rock art with the patterns of pottery in archaeological cultures and speculated that the age

of this rock art should be between the Erlitou Culture Phase 1 (1750–1680 BCE) and the Shierqiao Culture (1700–771 BCE). At the same time, he believed that vertical-eye rock art should be symbols of the ancestor gods through relevant historical records and that they mainly served the function of protection. He proposed that rock art should be studied in conjunction with archaeological discoveries, historical records, myths, legends and other information and should never be viewed in isolation. The relationship between time and space comes from the society at that time, which determines rock art's overall characteristics and motifs.

Xiage Wangdui discussed rock art at rDzus brag gdong, Tibet. He pointed out that the Nianchu River Basin is an important agricultural production area in central and southern Tibet. Most people think that this area will not have rock artworks reflecting scenes of livestock life like the high-altitude nomadic areas in northwest Tibet. However, as the breadth and depth of archaeological work in Tibet have increased in recent years, new rock art discoveries are changing our understanding. After investigating the rock art in rDzus brag gdong, he found that the rock art there not only reflected herding, hunting etc., but also had motifs such as riding a deer, animals, pagodas and some written records. He observed that the production methods of these rock art were mainly pounding and grinding and believed that this rock art site is an important representative of many rock art sites found in the Nianchu River Basin or the southern region of the middle reaches of the Brahmaputra River. It provides rare first-hand information for understanding the spread, subject matter expression and cultural characteristics of valley rock art in areas where agriculture and animal husbandry intersect. Its discovery also provides a unique perspective for re-understanding the development of plateau regional culture and the evolution of civilisation.

Nyima Jiangcai discussed a motif that looks like the 'labyrinth' in one of the ancient petroglyphs in Chengduo County, Qinghai Province. That motif is located on a rock in Gengzhuo Village, next to farmland and to the south by the Tongtian River in the upper reaches of the Yangtze River. By the lines in the rock art, he believes that this motif is a spiritual expression made by the creator following a specific symbolic meaning and based on the local visual aesthetics and belief trajectory. He also pointed out that such motifs have different names in Tibetan, and most of them have the meaning of 'labyrinth'. In addition, he proposed that such motifs have been inherited and developed in Tibet and are widely used in various ceremonies, becoming an ancient symbolic culture.

Zhang Wenjing analysed the regional distribution pattern of rock paintings on the Inner Mongolia Plateau. She pointed out that among the rock art systems in northern China, the Inner Mongolia Plateau rock art is numerous and rich in rock art types. She found that the rock art motifs on the Inner Mongolia Plateau are mainly about animals. In addition, there are also types of rock art such as figures, 'hunting', 'grazing', footprints, vehicles, human faces, symbols and cupules. Based on them, she conducted statistics and analysis on the rock paintings on the Inner Mongolia Plateau, divided them into various regions, and summarised the overall distribution characteristics of the rock art in that area. Her efforts initially established a basic framework for the distribution of rock art on the Inner Mongolia Plateau, laying the foundation for subsequent rock art research in that area.

Xiawu Kaxian and Wu Hao discussed two painted rock art sites they discovered in Linzhou County, Tibet. They pointed out that the Qiangpunang cave rock paintings and the Zawurong open-air cliff rock paintings are the first two ancient painted rock art remains discovered in central Tibet so far. Their motifs mainly focus on collective 'hunting', 'battles', 'sacrifices to gods', 'tribal migration' etc. There are certain Tibetan inscriptions around the panel, and some motifs are even painted on top of the Tibetan inscriptions. Some of the motifs of 'gods' and 'birds' in the panels have certain regional characteristics. They believe that the design, subject matter, painting techniques and other aspects of the panels of the Qiangpunang and Zawurong rock paintings have a certain meaning in the rock art on the Northern Tibetan Plateau. Judging from the content of the inscriptions around the panels, the age of the rock paintings may not be earlier than the Song and Yuan Dynasties.

Pang Ying discussed the motifs of draft animals in the rock art of the Hexi Corridor. She pointed out that draft animals are a general term for various large-scale livestock that provide power for farming, transporting, riding etc., including cattle, horses, donkeys, mules, camels etc. After observing the rock paintings in the Hexi Corridor, she believed that the large livestock reflected in the rock paintings were mainly cattle, horses, camels and donkeys. Based on the way these animals worked, she classified them into riding animals (used for hunting, warfare or riding), pack animals (used for transport), and farm animals (used for farm work). She believes that the emergence of these motifs provides evidence for the academic community to discuss the era, process, transmission routes and even related animal domestication methods (grazing methods, riding domestication etc.).

Xiao Bo compared the Zuojiang rock art in Guangxi and the Pha Taem rock art in Laos. He introduced Pha Taem rock art as one of the most representative sites in Laos rock art and of high artistic and historical value. The rock paintings are all painted with red or reddish-brown pigments and include anthropomorphs, handprints, zoomorphs, boats and abstract symbols. They reflect the sacrificial scenes of Laos' ancestors. Through cross-dating analysis, he believes that the age of the Pha Taem rock paintings is about the middle to late Western Han Dynasty, slightly later than the production time of the Zuojiang rock paintings in

Guangxi. By comparing the environment, pigments and motifs, he found that there is a close relationship between the Pha Taem rock paintings and the Zuojiang rock paintings, and they share certain spiritual concepts. This may also show the ethnic connection between the rock art creators.

4. Conclusion

This seminar provided a platform for scholars to discuss how to develop rock art science in a multidisciplinary manner. In this seminar, we are glad to see that many scholars actively discussed which disciplines can participate in rock art research and how they can contribute to this field. We have also seen that some scholars applied scientific technology to rock paintings, which has improved our ability to record, date, conserve and interpret rock art to varying degrees. In addition, humanistic rock art research is still active. It combines evidence from archaeology, history, ethnology, art history etc. to interpret rock art and try to understand the ethnic groups of these creators and their spiritual world. These efforts attracted public and government interest, increased the discipline's funding, and allowed more people to participate in research. Overall, Chinese rock art research has shown multi-disciplinary participation and is moving towards a scientific paradigm.

In the future, more efforts should be invested in introducing methods and technologies from proper science into rock art research. This means that we should actively pay attention to the progress of related disciplines and think about how those developments can help us analyse, record, date and conserve rock art. In particular, we should explore the discrimination of natural and artificial rock markings more because this is currently a relatively slow development part of Chinese rock art science. This is also a prerequisite for subsequent research. Also progressing slowly is the study of technological details of producing ancient rock art, which relies on developments in experimental archaeology. In addition, humanistic rock art research is still popular in China. Although it has benefited the discipline, we need to be aware that such studies are not actually proper science due to the untestable nature of their propositions. The fact that certain paint residues on a rock face resemble the shape of something cannot be denied outside the proposer's brain. Moreover, the practice of comparing styles in rock art is also often unreliable. While rock art traditions certainly possess stylistic parameters, they may not be detectable in the way alien researchers often imagine. Therefore, the interpretation of rock art is an area of great controversy. Often, as the zeitgeist changes, our interpretations of rock paintings change as well. Compared with interpretation, investing more efforts in scientific identification, recording, dating, and conservation of rock art, as well as understanding their production technologies, should be our tasks in the next stage. As Prof. Bednarik said, only when we have assembled exhaustive rock art science can we credibly interpret *some* aspects of rock art.

Finally, it is necessary to emphasise that rock art science serves the endeavour of understanding the cognitive and intellectual world of past and present societies and, ultimately, perhaps, in determining how our species acquired its very concepts of reality. In fact, since most Chinese rock art researchers are archaeologists, they hope to reconstruct ancient history and tend to use evidence such as historical records to understand the spiritual world of ancient people. However, many historical records contain the imagination of ancient people, so using humanistic approaches to interpret rock art is often inventing mythologies. Instead, rock art science seeks to explore the origins of human constructs of reality by examining physical remains. If we can conduct research within a scientific paradigm, we might discover how humans developed their ontologies and how the conceptual constructs humans have perceived as realities came into being. It is hoped that this potential of rock art science can be explored more deeply in the future.

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