

## Sally's Rockshelter and the Archaeology of the Vision Quest

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*Quartz, the most common mineral on earth, is almost universally associated with shamans. Why this ritual association occurred worldwide has remained unexplained scientifically, at least in part because western scientific thinking assumes that religious beliefs and practices are epiphenomenal and not worthy of study. This association is archaeologically evident at Sally's Rockshelter, a small rock engraving-vision quest site in the Mojave Desert, where quartz rocks were placed as offerings in cracks around the rock art panel. SEM and electron microprobe foreign materials analyses of Mojave rock engravings show that the association between quartz and rock art was common: almost 65 per cent contained remnants of quartz hammerstones, used to peck the motifs. A combination of ethnohistory and physical sciences explains why quartz, shamans and vision questing were so strongly associated: triboluminescence causes quartz to glow when struck or abraded, which was believed a visible manifestation of supernatural power. Recognition that this belief and behavioural association were based on quartz's physical properties aids our ability to identify the antiquity of the vision quest in the far west, suggesting that Mojave Desert shamanism is the oldest continuously practiced religious tradition so far identified in the world.*

The scientific study of prehistoric religion (including ritual, symbolism and belief) is a subject of growing interest in archaeology (e.g. Marcus & Flannery 1994; Renfrew 1985; 1994) yet, for many processual archaeologists, religion continues to be thought epiphenomenal (Flannery & Marcus 1993, 261). This means that it is a secondary or derivative phenomenon that is probably psychological in origin, therefore scientifically suspect, and as a consequence analytically irrelevant. Related to this perception of irrelevancy is our catch-all category, 'ceremonial object', which is commonly applied to artefacts with unknown technical functions. Since artefacts of unknown function are categorized as ceremonial, a conceptual transposition implies that prehistoric ceremony and its adjuncts are, in essence, unknowable. Because what we do not know is ceremonial, prehistoric ceremony is then by implication the ultimate archaeological unknown.

There are two problems with the view that reli-

gion, symbolism and belief are epiphenomenal, aside from the logical fallacy of inferring that prehistoric ceremony is inherently or necessarily unknowable. One of these problems is philosophical and concerns the ultimate nature of things; the other is practical and involves the way that we conduct research. First, reflecting processual archaeology's behaviourist roots (Peebles 1992; Whitley 1992a), most archaeologists maintain a materialist philosophical stance that denies ontological pluralism (Sperber 1992). This holds that non-materialist phenomena, like mental beliefs, cannot have material consequences (see Gardner 1985). Yet it is manifestly apparent that ritual and belief can result in behaviour with material consequences. Temple mounds are an obvious example, but so too are rock art motifs and other kinds of religious iconography, as well as the numerous 'ceremonial objects' described (but not analyzed) at the ends of our site reports. Second, the practical problem with the dismissal of these phenomena is seen in

the U.S. Native American Graves Protection and Repatriation Act (NAGPRA) of 1990. Even as Americanist processual archaeology maintains that beliefs are irrelevant to archaeological science, Native American religious beliefs are effectively stripping us of aspects of our archaeological record, as Leone (1991) predicted could occur some years ago. Religious beliefs may apparently have profound material consequences, including partly determining the way that the archaeological science which denies their importance may be practised.

Rather than epiphenomenal (or psychologicistic), anthropological research has shown that many traditional symbols, beliefs and rituals have their origin in observations about physical properties of the natural world; properties that provide 'natural models' which serve as a kind of logic upon which cognitive systems of symbolism and belief are constructed. Durkheim and his associates, for example, were the first to identify the conceptual analogy between the human body and human society that is embedded in the logic of African witchcraft (Crocker 1985, 20–21). More recently, ethnologists like Wilbert (1987; 1993) have shown how detailed knowledge of natural history, including such things as the psychochemical properties of plants and the behaviour of animals, forms the basis for certain indigenous New World symbolic systems. The importance of animal behaviour as a source of natural models which structure prehistoric symbolic and iconographic systems has also been noted by archaeologists (e.g. Linares 1977; Lewis-Williams 1981; Whitley 1994a, 24–8). The key point that derives from these studies is that religion and symbolism are not necessarily founded on irrational beliefs or psychologicistic impulses. They may instead be as logical as the workings of an ecological system, because it is just these kinds of natural systems from which they are at least in part conceptually derived and organized.

The interplay between natural phenomena and prehistoric cognitive systems is most strongly revealed by rock art research, especially the study of shamanistic rock art. To take one example, numerous authors worldwide have identified geometric motifs, very common components of most rock art assemblages, as representations of entoptic phenomena (e.g. Blackburn 1977; Wilbert 1981; Hedges 1982; 1992; 1994; Lewis-Williams 1986; 1991; 1995; in press; Lewis-Williams & Dowson 1988; 1989; Bradley 1989; Cytowic 1989; Dowson 1992; Sales 1992; Dickey 1994; Loendorf 1994; Parkman 1994; Ritter 1994; Stoney 1994; Whitley 1994b; Clottes & Lewis-Williams 1996; Dronfield 1996; Blundell 1998).

Entoptics are generated within the human optical system during an altered state of consciousness (ASC), a defining characteristic of shamanistic religious systems (Winkelman 1992). The form of certain shamanistic rock art symbols is then determined by regularities in the human neuropsychological system. This linkage between the mental imagery of trance and rock art has expanded our understanding of the origin of specific motifs in ethnohistorically documented corpuses of art; has provided us with an analytical model useful for determining whether prehistoric corpuses of art may or may not have been shamanistic in origin (see Lewis-Williams & Dowson 1988; Bradley 1989; Dronfield 1996); and has changed our perspectives on the nature and significance of art 'styles' (Whitley 1994b).

In North America, Whitley (1994a; 1998a; in press a) has combined ethnohistorical data with neuropsychological information on the somatosensory effects ('bodily hallucinations') of ASC to explain some of the putatively universal symbols common to shamanic art (see Eliade 1964). He has shown, in the process, that these symbols are metaphors for the neurological, emotional and physiological reactions to ASC that are common to all anatomically-modern humans (see also Lewis-Williams & Loubser 1986; Schaafsma 1994; Turpin 1994a). Trance, commonly called an 'ecstatic state', is a notoriously ineffable experience. This leads to great difficulties in verbalizing or graphically illustrating the experience. The cross-culturally shared solution to this communicative problem has been to employ metaphors originating in the bodily and emotional effects of ASC. The metaphor 'going on a trip' provides a good example (Turpin 1994a). This was a common metaphor for a drug-induced trance in American culture during the 1960s and 1970s. Precisely this same metaphor is used, but by entirely independent 'invention', by the Cashinahua, a lowland South American group, to describe their ritual trance experiences (Kensinger 1973, 11). The cross-cultural regularity in the use of this symbolic metaphor for ASC does not derive from some undefined 'psychic unity' of humankind, as the epiphenomenal view of symbolism would imply. It results instead from a series of common physiological reactions that can accompany trance: vertigo, weightlessness and impaired vision, among others. These are physiological effects that are every bit as 'material' as the hunger pangs that drive the human food quest.

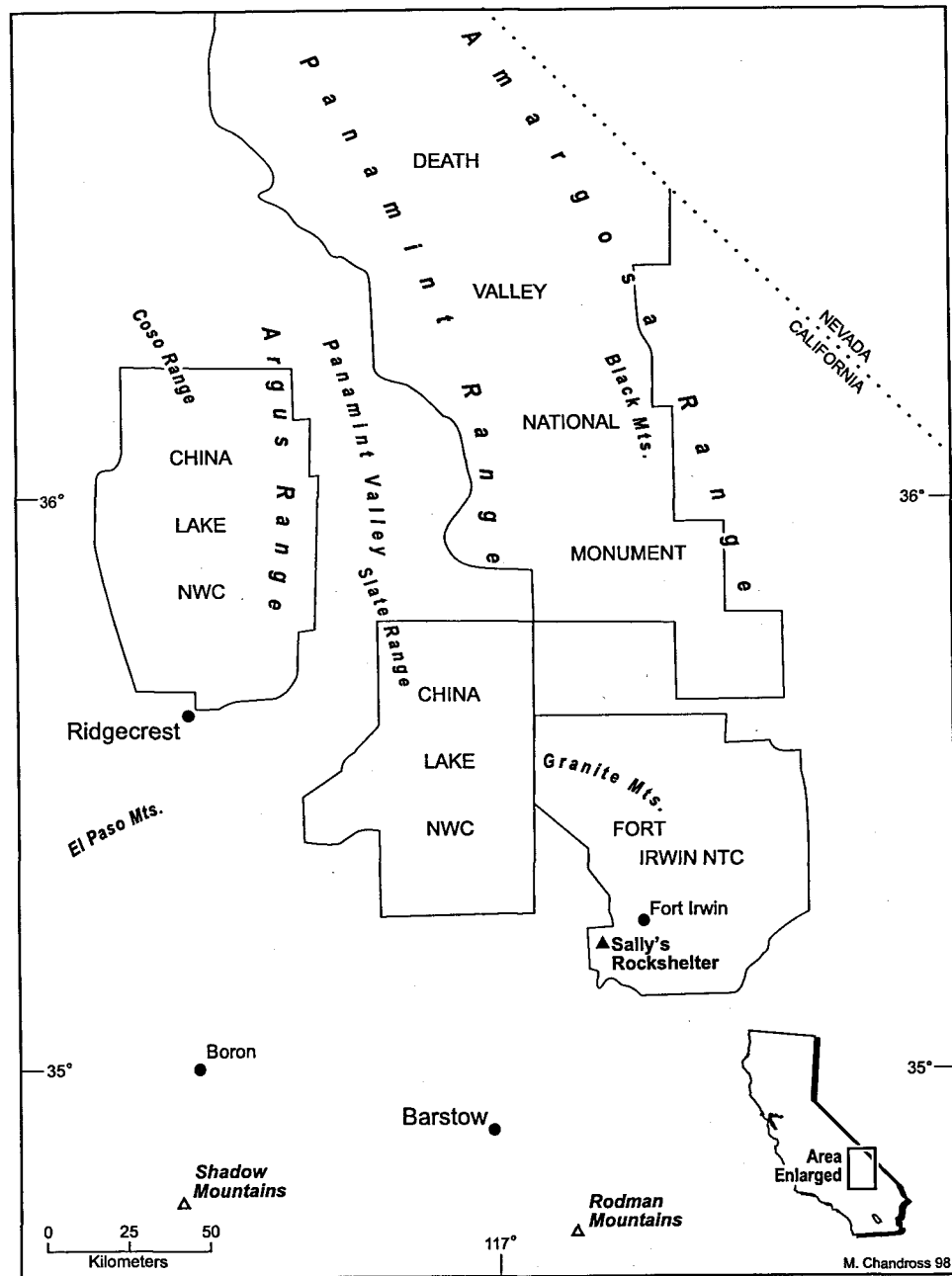
Note, however, that such reactions are common but not invariant reactions to ASC. Initial conditions and context, external stimuli, and personal

expectations can strongly influence the specific nature of the somatosensory (and mental imagery) effects of an ASC (Dobkin de Rios 1984; Dobkin de Rios & Winkelmann 1989). This means that these symbols are cross-culturally shared but not necessarily universal, thereby implying no biological or neurological reductionism. The outcome instead is variability in the resulting symbolism, but variability that falls within an expectable range. Shamanistic symbolic behaviour, from this perspective, is patterned, because of our shared neural architecture and cellular processes. But it is not fully predictable, because these cellular processes themselves can vary from case to case (see Damasio 1994, 112; Hobson 1994, 215; Kosslyn & Koenig 1992, 421).

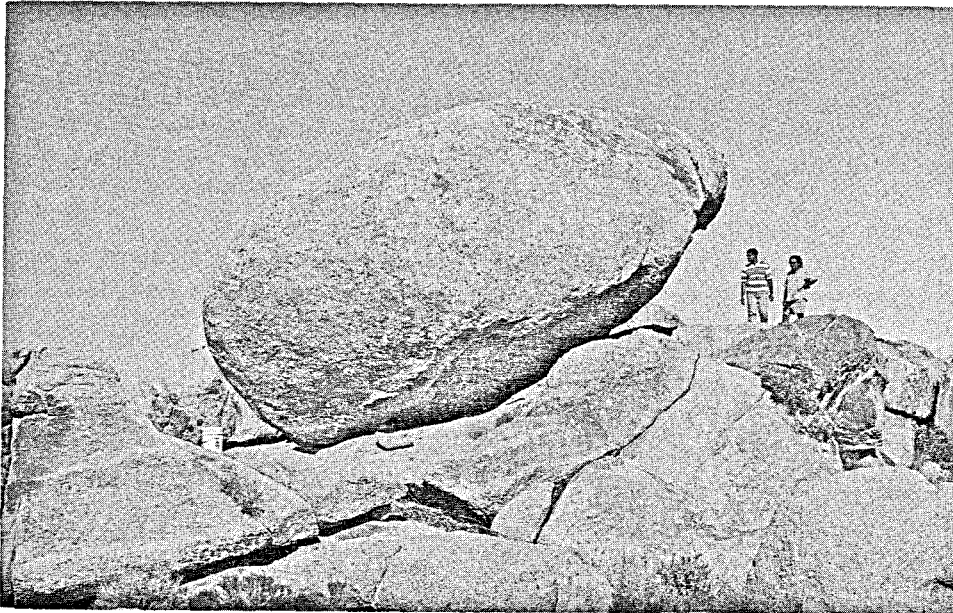
The importance of the common use of natural models among traditional societies to the study of religion, symbolism and belief is then straightforward. Inasmuch as the symbolic logic underlying iconography, ritual and belief is at least partly based on observable characteristics of natural phenomena, a detailed understanding of these same natural phenomena can inform our understanding of religion, in some cases without the benefit of an informant's exegesis. And where these natural phenomena are based on physical laws or are otherwise invariant over time, an understanding of them can contribute to the reconstruction and/or explanation of prehistoric religious systems. Natural models provide us with an interpretive key useful for unlocking

aspects of prehistoric beliefs.

In this essay we discuss the archaeology of Sally's Rockshelter, a small site located in the north-central Mojave Desert, California (Fig. 1). The archaeological record at this site is unusual because it primarily consists of a single panel of rock engravings along with a series of white quartz flakes and



**Figure 1.** The Mojave Desert, eastern California, showing three rock engraving sites/localities discussed in the text: Sally's Rockshelter, the Coso Range and the Rodman Mountains. A fourth Mojave Desert rock engraving locality, the Cima Volcanic Field, is located about 80 km east of Sally's Rockshelter, and is off the map.



**Figure 2.** *Main site components at Sally's Rockshelter, viewed from the east. The rockshelter is located at the bottom centre of the large central boulder; the upper depression is at the top of this boulder; the two individuals stand in front of and are looking at the rock engraving panel.*

cobbles. Our discussion varies from previous considerations of shamanistic rock art inasmuch as we are primarily concerned with these white quartz rocks, rather than the mental imagery and somatosensory effects of ASC, and their relation to the art. As has been shown in other regions (e.g. Taçon 1991; Hosler 1995), intrinsic but often archaeologically unrecognized properties of raw materials played important roles in their selection and use. These physical properties provided the symbolic logic that underlies widespread but heretofore unexplained patterns in human ritual behaviour. The one that we address here, which is common to indigenous New World religions, is the association of quartz with shamans and shamanic ritual. The examination of this problem also allows us to consider an issue of equal merit: the time-depth of the shamanistic vision quest and its associated beliefs and practices in far western North America.

We begin with a description of the archaeological record at Sally's Rockshelter. Next we turn to comparative analytical data, derived from a foreign materials analysis of rock engravings, to identify the commonness of the archaeological association between rock engravings and quartz which is so evident at the site. Ethnohistorical and ethnographic data are then used to explain the origin, function

and meaning of the rock engravings, and the importance of the association between rock engravings and quartz. We conclude with a consideration of certain of the physical properties of quartz that give a symbolic logic to this association and, by applying the Direct Historical Approach to our archaeological evidence, what the time-depth of this association implies about the antiquity of the vision quest in the far west.

#### **The archaeology of Sally's Rockshelter**

Sally's Rockshelter (CA-SBR-4895) is located in a grano-diorite boulder field within the U.S. Army's Fort Irwin National Training Center in the north-central Mojave Desert, California.

Although physiographically within the Mojave Desert, during the ethnographic period (and probably for much of the prehistoric past) this region was culturally a part of the Great Basin. Numic speakers, probably Southern Paiute/Chemehuevi or the closely related Kawaiisu, are believed to have occupied this area prior to Euro-American contact in the late eighteenth century (W&S Consultants 1996a).

There are three primary components of the site, arrayed essentially vertically within a large boulder pile (Fig. 2). At the base is a small and low-ceilinged rockshelter with a low density surface lithic scatter, but no subsurface deposit. A small surface scatter of lithics is also present immediately south of the shelter. The second site component is a panel of rock engravings (Fig. 3). This is located on a vertical portion of the large boulder that forms the roof of the rockshelter. The third and highest component of the site is a small depression (2.75 by 1.65 metres) at the top of this same large boulder (Fig. 4). This depression has filled with soil, and also contained a surface lithic scatter but no subsurface deposit. It is important to note that we needed a sixteen-foot ladder to access this depression: it is approximately 3.8 metres above the bedrock floor at the base of the rock en-



**Figure 3.** Tracing of rock engraving panel at Sally's Rockshelter. The very coarse rock surface of the grano-diorite boulder resulted in a relatively difficult surface to engrave, one result being that a number of the motifs are more rightly abraded onto the panel, and thus are fairly generalized images. Scale: ~10 per cent.



**Figure 4.** The upper soil depression at Sally's Rockshelter, viewed from the south. This depression contained a surface scatter of white quartz shatter and two hammerstones, which are visible along the left side of the depression rim.

graving panel. In addition to these primary site components, an unusual but interesting feature is a series of unmodified quartz cobbles that had been artificially pushed into various cracks in the granodiorite boulder pile (Fig. 5). All evidence at the site pointed to a single temporal component and, perhaps, prehistoric use. Its location, within the confines of an armoured cavalry training facility, has apparently contributed to its pristine condition.

Fieldwork at the site included the documentation of the rock engravings, excavations in the rockshelter and in the upper soil depression, the collection and mapping of surface artefacts, and the collection of the quartz cobbles wedged in cracks in the boulder pile. The two primary components of the 'artefact assemblage' from the site are the surficial lithic remains and rock engravings. In addition to a small amount of debitage and a few worked tools



**Figure 5.** One of six unmodified white quartz cobbles that were wedged in cracks between boulders at Sally's Rockshelter. Length of cobble: ~12 cm.

(Table 1), the lithic assemblage from the site contains a notable quantity of unworked white quartz: fifteen unmodified cobbles and pieces of broken shatter, and three cobbles with edge battering indicating their use as hammerstones, but no true flakes or flake tools. The quartz remains included six unmodified cobbles which were found wedged in cracks in the boulders; seven pieces of angular shatter and two hammerstones from the surface of the upper depression; three pieces of shatter in the lower rockshelter; ten pieces of shatter on the ground surface near the shelter; and another hammerstone found lying about 100 metres to the west.

Note that while the granodiorite boulders contain feldspar crystals that are off-white in colour, no quartz crystals, veins or outcrops were present at the site, nor in the immediate site vicinity. The placement of the quartz rocks at the site was therefore cultural. Moreover, two pieces of angular shatter recovered from the upper depression could be refitted, indicating that this quartz was fractured at this location. This conclusion is supported by the associated quartz hammerstones, as well as the distribution of the lithic specimens, all of which were found arrayed along the southern edge of this depression. Unmodified quartz cobbles were, then, intentionally placed in boulder cracks at Sally's Rockshelter, while quartz rocks were broken in the upper depression, and perhaps in and around the lower rockshelter.

The rock engraving panel at Sally's Rockshelter contains what we identify as 18 discrete motifs, which are classified in Table 2. Three of these have been identified as 'iconic' images: two 'stick-figure humans'; and a rattlesnake. The rattlesnake motif is a short zigzag and is so-identified because zigzags were universally called rattlesnake motifs by ethnographic informants in this region (Whitley 1992b, 95). As with many symbols in the far west, the association between the zigzag motif and the rattlesnake was based on a natural model: the zigzag is the pattern that the sidewinder leaves in the sand, just as a diamond-chain pattern may also be used to symbolize rattlesnake, because it duplicates the scale pattern on the back of the diamondback rattlesnake (e.g. Strong 1929, 298, 314; Harrington, in Oxendine 1980, 43).

The remainder of the motifs are 'geometrics'. They include a set of common entoptic forms ('dot patterns': see Lewis-Williams & Dowson 1988; Lewis-Williams in press) as well as integrations of simple entoptics into more complex geometric images. (Note that the zigzag is also a common simple entoptic percept.) Such integration, for instance the 'grid-

**Table 1.** *Lithics from Sally's Rockshelter.*

Provenance		Quartz	Other lithics
Boulder cracks	Unmodified cobbles	6 (5 collected; weight 694.7 g)	—
	Tools	—	—
	Debitage	—	—
Upper depression (surface collection unit no. 1)	Unmodified cobbles	7/253.7 g	5/476.8 g
	Tools	2 hammerstones/300.1 g	—
	Debitage	—	—
Lower rockshelter	Unmodified cobbles	3/111.35 g	—
	Tools	—	Quartzite chopper/107.1 g Quartzite hammerstone/166.7 g Basalt chopper/397.8 g Chert biface edge/0.9 g 12 flakes/11.3 g; 1 core/480.9 g
	Debitage	—	—
Surface collection unit no. 2	Unmodified cobbles	10/268.1 g	—
	Tools	—	Rhyolite uniface/60.2 g
	Debitage	—	14 flakes/68.3 g
100 m west		1 hammerstone/483.0 g	—
Totals	Unmodified cobbles	15	5
	Tools	3 hammerstones	5 miscellaneous
	Debitage	—	17 flakes, 1 core

rons' seen in Figure 3, is another characteristic of the mental imagery of trance.

Superpositioning of motifs (another characteristic of trance imagery) on the upper left-hand side of the panel suggests at least two episodes in the manufacture of the rock engravings, although it is impossible to estimate the temporal difference, if any, between these 'episodes'. No visible rock varnish has formed within the engraved surfaces of the rock engravings, nor is significant rock varnish present on the exposed natural surfaces of the boulder pile comprising the site, nor on similar boulder piles in the immediate vicinity. Rock varnish is a common phenomenon on stable geomorphological surfaces in this part of the Mojave Desert. The absence of a varnish coating at the site may therefore reflect the rapid weathering of the boulders. This has three important implications, the first of which concerns chronometric dating. The most commonly applied chronometric technique for Mojave Desert rock engravings is cation-ratio (CR) dating (Dorn 1994; see Dorn & Whitley 1983; 1984; Whitley & Dorn 1987; 1988; 1993; Whitley *et al.* 1999), which requires the presence of an intact and layered rock varnish coating. The absence of such a coating precludes CR dating at the site (as well as additional

**Table 2.** *Rock engraving motifs from Sally's Rockshelter.*

Motif type	No. examples present
Stick-figure anthropomorphs	2
Zigzag/rattlesnakes	1
Gridirons	2
Dot patterns	1
Vertical lines	3
Complex curvilinear patterns	6
Complex rectilinear patterns	3
<b>Total</b>	<b>18</b>

experimental rock varnish dating techniques). Second, the absence of a varnish coating also precluded a foreign materials analysis of the rock engravings, as is discussed for a series of other rock engraving localities below. Third, even while no chronometric dating or foreign materials analyses could be then conducted with the Sally's Rockshelter rock engravings, the clear surficial instability of the grano-diorite boulders and the inability of this surface to support rock varnish growth means that the rock surfaces are necessarily youthful. In the nearby Coso Range, for example, moderate varnish growth has been esti-

mated to require a minimum of 1000–1500 years (Whitley 1994c). While we do not have any chronometric ages on the Sally's Rockshelter engravings, the limitations imposed by rapid rock surface weathering rates suggest strongly that the site is less than approximately 1000 years in age, and an age of less than 500 years seems even more plausible. Although we do not have any temporal diagnostics or chronometrically datable material among the other archaeological remains from the site, the association with the rock art suggests that they are coeval in age. Our argument is admittedly inferential, but all existing evidence supports the interpretation that the site is roughly one thousand years in age or less.

### Foreign materials analysis of rock engravings

The association of rock engravings with white quartz rocks at Sally's Rockshelter encouraged us to investigate this phenomenon at other sites. Since site visitation, vandalism and other cultural factors have eliminated associations between rock art and surface artefacts at many sites, we used electron microscopy to examine very small chips of rock varnish removed from rock engravings at three different rock art localities in the Mojave Desert. The intention was to identify foreign lithic materials forced into the weathering rind of the rock, or encapsulated between the engraved heart-rock and the varnish layer, that might reasonably be interpreted as remnants of the hammerstones used to create the rock engravings. Millimetre-sized chips of rock removed from 35 rock engravings were examined using back-scattered electron microscopy (BSE), wavelength dispersive spectrometry (WDS) and energy-dispersive spectrometry (EDS; see Reed 1993). The rock engravings examined included ten each from the Coso Range (Whitley & Dorn 1988; 1993) and the Cima Volcanic Field (Whitley & Dorn 1987), and 15 rock engravings from three other rock engraving sites on Fort Irwin (W & S Consultants 1996a; 1997). The rock art at each of these localities is found on quartz-free basalt. Additional rock engravings from another Mojave Desert locality, the Rodman Mountains (W&S Consultants 1996b), were also examined. These were eliminated from the analysis because quartz was found to be present in the host basalt at this location.

Of the 35 rock engravings from quartz-free basalts, quartz grains were found embedded up to 1.1 mm into the host rock matrix in 22 cases, or 62.9 per cent of the total (Table 3). The embedded quartz is surrounded by minerals characteristic of basalt,

such as olivine, clinopyroxene and plagioclase (Fig. 6:c, d, e, g, j, k, m, o, p & r). In a few samples the basalt appears to be crushed (Fig. 6:c, d, j, p & r). The preservation of these delicate features is owing to the development of the rock varnish coating, and the embedded quartz grains are apparently preserved traces of quartz or quartzite hammerstones, used to create the rock engravings. Quartz grains were also found at the interface between the host basalt and the rock varnish in six further cases (17.1 per cent of the total; see Fig. 6:f, h, i, l, n & q). These may represent remnants of hammerstones, or the quartz grains may be aeolian in origin. No other foreign lithic materials were found in any of the 35 rock engravings examined, including the nine lacking quartz grains. It is possible that these rock engravings too were made with quartz or quartzite hammerstones, but evidence of the engraving tools was either not preserved, or missed during the sampling procedure. Still, positive evidence for the manufacture of rock engravings with quartz or quartzite hammerstones was found in almost 63 per cent of the cases. If the interface quartz grains are the remnants of tools rather than the result of aeolian deposition, this figure increases to over 82 per cent of the total.

The 35 rock engravings examined in this study have all been temporally constrained using cation ratio (CR) dating (Dorn 1994), an experimental technique that provides minimum calibrated ages for the rock varnish that coats the rock engravings.<sup>1</sup> The ages of the rock engravings with embedded quartz range from  $250 \pm 100$  to  $12,600 \pm 1400$  BP, thereby ranging from the Late Pleistocene to the Holocene.

We emphasize that these CR ages are experimental and subject to revision. As in the history of radiocarbon dating, improved calibrations and field and lab techniques have enhanced the precision of this chronometric technique since its introduction (cf. Dorn 1983; 1989). Inasmuch as research to improve the technique is ongoing, we fully expect that these CR ages may be refined at a later date (as occurred recently through the substitution of cosmogenic for radiocarbon ages in the CR calibration curves). The current precision of the technique, however, is sufficient to argue from the above results that the use of quartz or quartzite tools for rock engraving was a long-lived tradition in the Mojave Desert that began at least during Palaeoindian times ( $>10,000$  BP), and continued at least into the Proto-historic Period.

As should be clear, the association between quartz and rock engravings seen at Sally's Rockshelter is by no means unique. Foreign materials



analysis and chronometric dating suggest that this association was both common and very ancient: quartz or quartzite hammerstones were selectively used for rock engraving for many millennia in the Mojave Desert. A ritual association between shamans and quartz is well-known worldwide (e.g. Benedict 1934; Eliade 1964; Taçon 1989) even though quartz is the most common mineral on earth. We therefore turn to ethnohistorical evidence, first, to understand the origin and symbolism of the rock engravings and, second, to find the connection between rock art and quartz rocks.

### Ethnohistory and Numic rock art

The Mojave Desert has perhaps the richest concentration of rock art sites in the Great Basin, with dozens of sites and tens of thousands of motifs in the Coso Range alone, and other large concentrations in the central and southern portions of the desert. Quite simply, this rock art is impossible to ignore, even for the processual archaeologist who views art as epiphenomenal. One result of this fact is a relatively long history of rock art research in the region, which began with Julian Steward's (1929) landmark study.

An outcome of this long history of research is near-unanimous consensus about the origin of the art. Since Alfred Kroeber's *Handbook of the Indians of California* (1925, 936–9), researchers have been in essential agreement that much if not most of the rock art in eastern California and surrounding regions is shamanistic in origin (e.g. Steward 1929; Gayton 1930; 1948; Driver 1937; Aginsky 1943; Heizer & Baumhoff 1959; 1962; Grant 1965; 1968; Applegate 1975; Blackburn 1977; Hedges 1976; 1982; 1983; 1992; Garvin 1978; Hudson & Underhay 1978; Riddell 1978; Wellman 1979; Wilbert 1981; Hudson & Lee 1984; Hultkrantz 1986; Whitley 1988; 1992b; 1994a,b,c; 1996; 1998a; 1999a; in press a,b; Christensen 1993; Dickey 1994; Ritter 1994; Stoney 1994). The reason for this consensus is straightforward even if widely misunderstood outside the far west: Native American cultures in this region were fundamentally shamanistic in their religious beliefs (Kroeber 1907; Park 1938). Indeed, it has long been believed that these shamanistic beliefs were part of the cultural baggage of the first inhabitants of the New World (e.g. Kroeber 1923, 349; Furst 1977, 20; La Barre 1980; von Gernet 1993). To argue that rock art of far western North America is not shamanistic therefore requires either that the art be non-religious in origin, or that it derive from a New World religion with no ethnographic analog. No plausible empirical evidence has been presented

**Table 3.** Quartz and chronometrically-dated rock engravings.

Engraving locality	Sample no.	Presence/ Location of quartz	CR age <sup>1</sup>
Fort Irwin <sup>2</sup>	96-1	Matrix	2500+500
	96-2	Matrix	2750+500
	96-4	Interface	1200+200
	96-6	Matrix	900+200
	96-8	Matrix	300+100
	96-9	Matrix	350+100
	96-10	Absent	1750+250
	96-12	Matrix	250+100
	96-13	Matrix	1150+250
	96-14	Matrix	300+100
	96-16	Matrix	4500+850
	96-18	Matrix	4700+1100
	96-19	Matrix	3300+500
Cima <sup>3</sup>	96-20	Matrix	3000+500
	96-22	Matrix	4800+600
	1-8	Interface	700+70
	1-7	Matrix	1100+200
	2-3	Absent	2100+100
	2-2	Matrix	2300+200
	1-1	Absent	2600+200
	2-1	Interface	4400+200
	1-2	Matrix	8400+1800
Coso <sup>4</sup>	2-5	Matrix	11,700+1000
	1-3	Interface	5300+200
	94-1	Absent	6400+900
	CM-14	Interface	1300+100
	CM-13	Matrix	1900+200
	CM-10	Absent	3600+300
	CM-16	Absent	5100+500
	CM-4	Absent	5100+500
	CM-3	Matrix	6800+700
	CM-2	Interface	7400+700
CM-6	Matrix	7800+600	
CM-7	Matrix	11,200+1200	
CM-8	Matrix	12,600+1400	

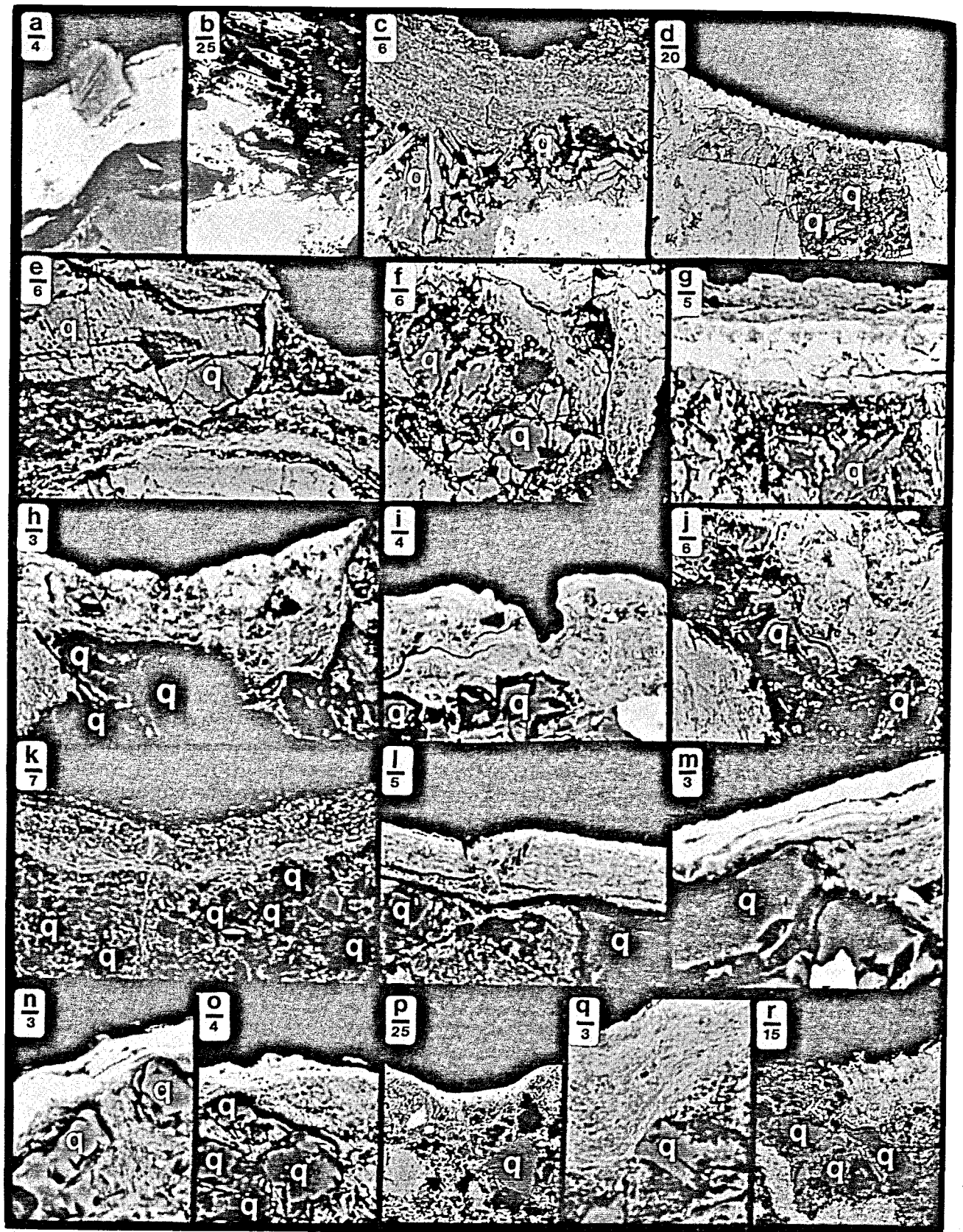
N = 35 engravings; 23 (65.7 per cent) with quartz embedded in rock matrix; 6 (17.1 per cent) with quartz at an interface position; and 6 (17.1 per cent) with no evidence of quartz or other foreign materials present.

<sup>1</sup> CR ages based on revised cation-leaching curve using cosmogenic and standard radiocarbon ages for calibration points.

<sup>2</sup> Descriptions of sites and motifs in W&S Consultants (1996a; 1997).

<sup>3</sup> Descriptions of site and motifs in Whitley & Dorn (1987).

<sup>4</sup> Descriptions of site and motifs in Whitley & Dorn (1988).



**Figure 6.** Foreign materials associated with petroglyphs, imaged by BSE (Reed 1993) where brightness is proportional to average atomic number. Scale bars in microns. Qualitative descriptions of chemistry and mineralogy determined by EDS. The symbol 'q' indicates quartz grains identified by WDS microprobe measurements. Examples illustrated are from the Cima Volcanic Field (Whitley & Dorn 1987), Coso Range (Whitley & Dorn 1988), Pinon Canyon, CO (Loendorf 1991), Bighorn Basin, WY (Francis et al. 1993), and Australia (Nobbs & Dorn 1993).

a. Chalk imbedded into rock varnish on a petroglyph in the Bighorn Basin (Francis et al. 1993), an example of foreign material added to the petroglyph since the rock varnish formed.

b. Cells of woody tissue (originally charcoal), trapped underneath rock varnish on a petroglyph in Australia; some organic material has been replaced in part by manganese and iron oxides, making them bright in BSE (Nobbs & Dorn 1993).

c. Cima 1-2: Clinopyroxene and plagioclase minerals were crushed, and mixed with quartz grains.

d. Coso CM-3: Plagioclase, clinopyroxene, and some olivine grains were fragmented, and mixed with quartz.

e. Pinon Cyn. 5LA5598-58-b: Weathered (porous) quartz grain above olivine, separated by rock varnish.

f. Cima 1-3: Weathered (porous) quartz between olivine (lower left) and rock varnish (upper right).

g. CM-8: Quartz grain rests adjacent to olivine and clinopyroxene, encapsulated by rock varnish with a Mn-poor (darker) layer resting over a layer enriched in Mn (brighter).

h. Pinon Cyn. 5LA5598-220-a: Fragments of quartz under rock varnish; note abundant detrital quartz grains (darker) within varnish.

i. Pinon Cyn. 5LA5598-174-a: Quartz trapped under rock varnish, and adjacent to olivine, clinopyroxene and magnetite.

j. Pinon Cyn. 5LA5598-246-a: Quartz in a zone intermixed with crushed plagioclase and olivine grains. Relatively solid olivine in lower left, and rock varnish on upper right.

k. Cima 2-5: Abundant quartz grains mixed with plagioclase in the weathering rind of the rock, all covered by rock varnish with a basal layer of Mn-rich (brighter) varnish.

l. Cima 2-1: Quartz and plagioclase under rock varnish.

m. Cima 1-7: Quartz, plagioclase, and magnetite under rock varnish.

n. Coso CM-14: Quartz in weathering rind, under rock varnish.

o. Coso CM-13: Quartz, imbedded in clinopyroxene,

to support this conjecture, and considerable data have been obtained which contradict it.

This is not to suggest, however, that there has been complete consensus on the origin and meaning of this rock art, nor that a single and unitary function has been identified. As Park (1938, 2) noted long ago: 'A merely superficial examination of North American shamanism reveals quite striking differences in content, in meaning, and in the way practices and beliefs are combined with other customs.' That the art is shamanistic implies nothing more than would the analogous statement that western European religious art is Judeo-Christian. Both assertions leave considerable room for variability in function, meaning, social importance, and change over time.

One shamanistic interpretation of Numic rock art posits an origin in some form of sympathetic hunting magic (Heizer & Baumhoff 1959; 1962; Grant 1968; von Werlhof 1965; Nissen 1974; Wellman 1979). This has been a popular, and widely cited, interpretation because it tacitly satisfies a functionalist assumption of behaviourist processual archaeology: that the purpose of religion is to aid adaptation to the environment. But since this kind of hunting magic was widely denied by ethnographic informants, the acceptance of the hypothesis entailed two problematic assumptions: that the rock art was necessarily prehistoric rather than at least partly ethnographic in age; and that a cultural disjunction existed between the ethnographic and prehistoric inhabitants of the region (Steward 1968). Chronometric and relative dating (including the identification of historical motifs in the art), compilations of ethnographic commentary on the making and meaning of the art, and historical linguistics and archaeological studies all deny the plausibility of these two assumptions. Eastern California rock art was clearly made into the ethnographic period (Whitley 1982; Whitley & Dorn 1987) and, since eastern California is considered the Numic heartland (Lamb 1958; Fowler & Fowler 1971; Bettinger & Baumhoff 1982), considerable linguistic, ethnic and cultural continuity can be assumed be-

under rock varnish.

p. Coso CM-6: Quartz grain in weathering rind, surrounded by olivine, magnetite, clinopyroxene, and plagioclase.

q. Coso CM-2: Quartz, surrounded by olivine, all covered by rock varnish.

r. Coso CM-7: Quartz, in zone of crushed plagioclase and olivine, between olivine (lower left) and rock varnish (upper right).

tween the historic and prehistoric occupants of the region.

But there are other debilitating empirical problems with the shamanistic hunting magic hypothesis (Steward 1963; 1967; Rector 1979; 1985; Mundy 1981; Christensen 1993; Whitley 1994c; 1996; 1998b; in press b). The large majority of the rock art motifs at most sites are geometric patterns, not 'game animals' or 'hunters' that the hypothesis claims to explain, so the hypothesis fails to account for all but a small portion of the motifs at most sites. Likewise, while it was claimed that the sites were located on migratory game trails, re-examination has shown that many are associated with villages, not remote hunting locations. And since the primary animal motif in the art is the bighorn sheep, even the logic of the importance of sites on putative game trails is problematic, because bighorn sheep are non-migratory. In short, the shamanistic hunting-magic hypothesis is a classic example of inductive empiricism, founded on a biased use of the evidence. No significant data can be said to support it.

Recent analyses of Numic rock art have emphasized ethnohistorical data as the key to interpreting the recent rock art in the region (Whitley 1988; 1994a,c; 1996; 1998b; 1999a; in press b). A summary tabulation of these data is presented in Table 4. It shows that ethnographic informants were in widespread agreement about the origin and meaning of Numic rock art. In contrast to certain surrounding regions, the art was made by shamans, and shamans alone.<sup>2</sup> Moreover, rock art was made during the shamans' 'vision quests', broadly defined, during which they accessed the supernatural world by entering an ASC, and obtained and/or manipulated supernatural power (Lowie 1924, 295; Shimkin 1953, 409; Hultkrantz 1961, 201; 1981, 30–35; 1986, 54; 1987, 49, 54–5; Malouf 1974, 81–2).

The resulting relationship of the shaman to supernatural power and to rock art sites was encoded linguistically: supernatural power was called *poha*; shaman was *pohagunt*, '[man having] supernatural power'; while rock art site was *pohaghani*, 'house of supernatural power' (Malouf 1974, 81–2; Shimkin n.d.). Note, however, that an alternative linguistic gloss for *pohagunt* was obtained by John Wesley Powell in 1880. His translation was 'man who writes' (Fowler & Fowler 1971, 144), which is to say 'man who writes on rocks', or makes rock art, reflecting the fact that rock engravings were commonly called 'picture-writing' in the nineteenth century. This is because the shaman created rock art at the end of the vision quest; specifically, to illustrate the spirit be-

ings seen in his trance and other visionary experiences (see Lowie 1909; 1924, 295–6; Gifford 1932, 52; Driver 1937, 126; Hultkrantz 1986, 54; Liljeblad 1986, 644; Phillips 1986). Simply stated, Numic rock art portrays the visionary imagery of the shaman's trance.

At the neurochemical level, the creation of the rock art can be explained as a by-product of physiological changes that sometimes occur during ASC (Whitley 1998a). Short-term memory may be diminished during trance owing to declines in the levels of two neurotransmitters, serotonin and norepinephrine, which are required for memory formation (Hobson 1994, 211). For the same reason, most people do not recall their dreams during REM sleep, which is neurochemically similar to an ASC. On the neurophysiological level, the shaman made rock art so that he would not forget his supernatural experience — a conclusion corroborated by ethnographic accounts which emphasize the importance, and by implication the difficulty, of recalling the visionary dream (e.g. Kelly 1932, 189, 190, 194, 199; 1939, 152; Opler 1940, 141; Whiting 1950, 31; Gayton 1948, 109, 240; Applegate 1978, 50–51; Levi 1978, 49; Hultkrantz 1987, 55).

Two points must be emphasized in light of this ethnohistorical interpretation. First, it does not imply a single purpose or function for the art. Shamans made rock art as part of their rituals to acquire and manipulate power, but there was considerable room for functional (and ideological) variability within this general purpose. Some shamans obtained and used their potency for curing, others for rain-making, for warfare and fighting power, or for sorcery. The Coso Range, for example, contains a significant quantity of bighorn sheep rock engravings. These were the specialized spirit helpers of rain shamans, with the geographical concentration of these particular motifs reflecting the fact that this area was considered a localized nexus for acquiring and using rain-making power (Whitley 1994c; 1996; 1999a; in press b; Whitley *et al.* 1999). Hence not only did functional variability in the making and meaning of the art exist, but this functional variability is archaeologically manifest in the geographical variation in rock art sites and motifs across the Great Basin.

Second, whether or not this ethnographic interpretation may be applied to truly prehistoric rock art is a question requiring empirical evaluation, to which we return below. At this point, however, we wish simply to underscore the contention that this interpretation holds for the ethnographic past and for the so-called Numic Period, or the last approximately

**Table 4.** *Rock art and vision quests: ethnographic data.*

<i>Rock Art produced by Historic/Ethnographic Indians:</i>		
Gifford 1932	Steward 1933	Kroeber in Chalfant 1933
Driver 1937	Stewart 1943	Aginsky 1943
Laird 1976; 1984	Malouf 1974	Riddell 1978      Phillips 1986
<i>Vision Quests held at Rock Art Sites:</i>		
Lowie 1924	Shimkin 1953; n.d.	Hultkrantz 1961; 1986; 1987
Malouf 1974	Voget 1984	
<i>Rock Art Sites have Supernatural Power:</i>		
Zigmond 1977; 1986	Liljeblad 1986	Hultkrantz 1987
Shimkin n.d.		
<i>Rock Art Sites associated with Medicinal Powers:</i>		
Steward 1943	Heizer & Baumhoff 1962	Grosscup 1974
<i>Sites are Symbolic Entrances to Supernatural World:</i>		
Chalfant 1933	Gayton 1948	Zigmond 1977; 1980
<i>Rock Art made by Shamans:</i>		
Gifford 1932	Driver 1937	Aginsky 1943
Riddell 1978	Laird 1976; 1984	Phillips 1986
<i>Rock Art made by Spirit Helpers/Supernatural Spirits:</i>		
Lowie 1924	Reagan 1934	Kelly 1932
Voegelin 1938	Malouf 1940	Stewart 1941; 1942
Steward 1943	Laird 1976; 1984	Irwin 1980
Sutton 1982	Hultkrantz 1986; 1987	Zigmond 1977; 1980; 1986
<i>Rock Art depicts Spirit Helpers/Spirits seen in Vision:</i>		
Gifford 1932	Driver 1937	Riddell 1978
Phillips 1986	Shimkin n.d.	
<i>Rock Art depicts Shaman's Visionary Imagery:</i>		
Lowie 1909	Gifford 1932	Driver 1937
Hultkrantz 1987	Phillips 1986	Shimkin n.d.
<i>Correlation of Ethnographic Vision Quest and Rock Art Sites<sup>1</sup>:</i>		
Dayton Cave, NV	Wheeler Peak, NV	Back Canyon, CA
Indian Creek Cave, CA	Fallon, NV	Bull Lake, WY
Crowheart, WY	Dinwoody Canyon, WY	Medicine Butte, WY
Cedar Buttes, WY	Sage Creek, WY	Willow Creek, WY
Owl Creek, WY	Coal Draw, WY	Steens Mountain, OR
Coso Range, CA		

<sup>1</sup> Source: Whitley (in press b).

1000 years of the prehistoric record, during which considerable archaeological continuity with the ethnographic record is evident.

#### Ethnohistory and quartz

The ethnohistorical record also contains considerable information that informs our understanding

about ethnographic practices concerning three related issues pertinent to Sally's Rockshelter: the leaving of objects at rock art sites; the symbolic significance of cracks in rocks; and of course the importance of quartz. We address these in turn.

We have emphasized above the use of rock art sites for Numic shamans' vision questing, but two additional points must be noted. The vision quest

sometimes began by depositing an offering at the site, to the spirit that the supplicant wished to receive (Laird 1976, 38, 46, 74). Moreover, in addition to the primary function and origin of rock art sites in the shaman's vision quest, sites also served a secondary ritual purpose as locations to which non-shamans retreated to pray for cures, gambling luck, or good health (Lowie 1924, 208; Fowler 1992, 177–8). In such cases, again, offerings would also be left (though from the ethnographic accounts, no rock art was produced as a result of these secondary activities.) The offerings in both circumstances are described as beads, sticks, arrows, seeds and berries, a piece of buckskin, tobacco, moccasins or, in recent times, coins (Lowie 1924, 208; Driver 1937, 105; Laird 1976, 38; Fowler 1992, 177–8); in other words, small and seemingly insignificant items.<sup>3</sup> Fowler has stated that:

A person seeking a favor from a power, or seeking power itself, would go [to rock art site 26Ly3, Dayton Cave] and spend the night . . . Anyone who was successful at the cave had to pay it for its favors. People usually presented the cave with sticks, beads, arrows, and a variety of other items. (1992, 177)

Fowler (1992, 177–8) also noted that the ceiling of the cave was covered with small sticks and other offerings when visited in 1940, while another site contained numerous offerings when examined in 1950. We can reasonably infer that the offerings visible on the ceiling of the cave had been stuck in cracks in the rock.

A related practice, both for the shaman during his vision quest and for the non-shaman practising a self-cure, was the building of rock cairns (Laird 1984, 272; Miller 1983, 76). Laird (1984, 272) stated that, for rheumatism, 'An afflicted person brings with him a stone of any kind, of a size convenient for carrying in the hand. This stone might have been picked up close by, but more likely would have been carried a considerable distance . . . to be deposited on the rock cairn, which was built up, rock by rock. Rock cairns are occasionally associated with rock engraving sites in the Great Basin. While these have been interpreted as 'dummy hunters' used to take big-horn sheep (e.g. Grant 1968, 31–2), some of them may be ritual constructions consisting of stone offerings.

The ethnographic record shows that these Numic practices were also shared by a number of surrounding cultural groups. Simple offerings, for example, were commonly left at sacred spots by nearby south-central California and Colorado Desert

peoples (e.g. Kroeber 1925, 509, 567; Drucker 1941, 164). Robert Eccleston recorded in 1851 the placing of stones at the base of a southern Sierra Nevada pictograph site (presumably Yokuts) by people who had been cured at that spot (Crampton 1957, 65). Modern ethnographic fieldwork with the Wukchumni Yokuts in the southern Sierra Nevada has confirmed that, in this region, rock art was made exclusively by shamans (Whitley 1994b). This research has also, however, allowed one of us to participate with our informants in a non-shaman's curing ritual at a rock art panel, during which an offering of tobacco was made. And the creation of rock cairns was a common practice in south-central California shamans' vision quests (Gayton & Newman 1940, 43; Applegate 1978, 34); in the Colorado Desert by non-shamans seeking supernatural aid (Patencio 1943, 73; Bean *et al.* 1991, 96); and during children's vision quests on the Columbia Plateau, during which they also painted rock art to portray their visionary imagery, as well as during Plateau rituals more generally (see Teit 1896, 227; 1900, 317, 320–21; 1906, 275; 1909, 590; 1930, 194, 283; n.d.; Anonymous 1916, 3; Steward 1936, 413; Cline 1938, 138–9; Mandelbaum 1938, 111; Malouf & White 1953, 35; Leechman *et al.* 1955, 38; Caldwell & Carlson 1954; Chartkoff 1983; Buckley 1986; Jett 1986; Keyser 1992, 47–8; York *et al.* 1993; Winthrop *et al.* 1995; Hann *et al.* in press).

The ethnohistorical record, then, indicates that: (i) offerings were sometimes left at rock art sites; (ii) these offerings could be mundane, natural objects; (iii) natural rocks of various kinds were included among these offerings; and (iv) at least some of the offerings were stuck in cracks in the rock. Furthermore, these practices were widespread in the far west. From these facts we may reasonably infer that the quartz rocks and other unmodified but foreign stones found at Sally's Rockshelter were left there as ritual offerings.

The placing of the quartz offerings in cracks in the rocks warrants further comment. It appears to reflect a key belief about rock art sites specifically, and large rocks in general: rocks were believed numinous; the supernatural world was thought to lie within these rocks; and cracks in the rock were conceived as the portals into the sacred realm (Whitley 1992b; 1994a; 1999a). Among the Numic, for example, spirits were believed to reside 'inside' rocks, using cracks to move in and out of the supernatural, just as these same cracks were believed to open up for the shaman, when he entered his trance and went into the sacred realm (Wheeler 1875; Egan & Egan 1917; Chalfant 1933, 52–3; Steward 1938, 181, 187–8;

1943, 283; Park 1938, 28; Laird 1976, 46; Zigmond 1977, 71, 76; 1986, 406–7). Among Yuman speakers, similarly, rock art sites were recognized as entrances to the supernatural (Kelly 1977, 127). Likewise, among the Yokuts, cracks at rock art sites were recognized as the doors to the supernatural, and shamans' talismans were said to be stored in 'some rocky crevice' (Gayton 1948, 110, 113), while the Chumash along the Santa Barbara coast maintained the idea that entry into the supernatural required crossing rocks that opened and closed (Blackburn 1975, 108, 116–17, 255). These beliefs reflect a far western North American-wide conceptualization of sacred places as portals to the supernatural (Walker 1991; 1996). They explain why some rock art motifs are drawn as-if 'emerging' or 'entering' a crack in the panel face (see Whitley 1996, 110–14). And they also explain why quartz rocks were placed in the cracks at Sally's Rockshelter. Since these were offerings to spirits, and since spirits lived inside the rock, placing the quartz rocks in cracks was akin to leaving a gift at the spirits' door.

Although any number of mundane objects could have been used for offerings, only quartz rocks were placed in the cracks. Likewise, only quartz grains have been identified in the foreign materials analysis of rock engravings. While quartz (or quartzite) logically would make a good rock-engraving hammerstone (the hardness of quartz on the Mohs scale is 7), this fails to explain why quartz or quartzite alone was used for pecking, and especially why unmodified and unutilized quartz was exclusively placed in the cracks. This purposive patterning suggests that additional factors were at play in the selective use of this lithic material.

And, in fact, ethnographic evidence provides information pertinent to the understanding of quartz use. Bob Rabbit, the last known Numic rain-shaman in the Mojave Desert region (see Driver 1937, 59; Voegelin 1938, 64; Zigmond 1986, 406), for example, used quartz crystals and other rocks as part of his paraphernalia for weather control ceremonies (Zigmond 1977, 88). Similarly, Avenari, a Las Vegas Band rain shaman, used crystals (obtained from a place where lightning had struck) in his ceremonial kit (Kelly 1939, 165–6), while other shamans were said to receive dreams of rocks (of undescribed kinds) during their vision quests (Kelly 1936, 137; Whiting 1950, 29), which made them 'Rock Shamans'.

These Numic beliefs themselves reflect far western North American-wide attitudes about quartz, in general terms, and quartz crystals and other gemstones, more specifically. Quartz crystals were widely

associated with, and used ritually by, shamans and sorcerers (Sparkman 1908, 219; Kroeber 1925, 713; Toffelmeier & Luomala 1936, 198, 201; Devereux 1949, 111; Hohenthal 1950; Bean 1972, 145; Stewart 1973, 321; Harrington 1978, 128, 133–5; Levi 1978, 45; Miller 1983, 81; Shipek 1991, 49). Shamans in surrounding regions also sometimes had visions of these rocks (DuBois 1908, 183; Toffelmeier & Luomala 1936, 217, 219; Devereux 1949, 113). Crystals were believed 'inhabited' by spirits (Blackburn 1975, 33, 36, 37, 93, 131, etc.; Levi 1978; Miller 1983, 70) and thereby contained supernatural power that could be received and used for various purposes (Meigs 1939, 64; Levi 1978, 44, 47). Among Yuman speakers, quartz crystals were acquired during the shaman's vision quest (Levi 1978, 47), during which he also made visionary rock art (Whitley 1996; 1999a; in press a).

The quartz rocks at Sally's Rockshelter, appear to have been left as offerings at a vision quest locale, a place of great supernatural power, because quartz too was believed to have supernatural potency. It is then not surprising that an association between quartz and rock art has been noted at other far western North American sites. At Corn Springs in the California Desert, for example, a quartz vein has been incorporated into an engraved motif (Whitley 1996, 108, photo 23). At Balch Camp in the southern Sierra Nevada, similarly, pictographs have been painted over a quartz vein, and the quartz vein itself has been partly painted. At another rock art site (CA-SBR-5249) on Fort Irwin, a surface scatter of broken but otherwise unmodified quartz cobbles was found immediately below the scree slope containing the rock engraving panel, while imported but unmodified quartz cobbles have been identified in front of rock art panels at a number of other sites in the Mojave Desert. We suspect that the association between rock art and quartz is reasonably common, but heretofore simply has not been noticed by archaeologists.

Whether the quartz rocks lodged in the cracks at Sally's Rockshelter were left by one or more shamans during the vision quest(s) responsible for the rock engravings, or instead by non-shaman ritual supplicants at a later date, is unknown, although the association between shamans and quartz supports the interpretation that they derive from shamanic vision questing. Regardless, the quartz rocks and their placement in cracks were an expression of a coherent set of supernatural beliefs. Yet if these beliefs were logical and coherent, as we have contended from the start, an outstanding question remains. Why was quartz, the most common mineral on earth, so widely associated with shamans and supernatural power?

### The symbolic logic of quartz

The symbolic logic underlying the widespread use of quartz in ritual contexts is revealed by a combination of ethnographic and modern physical sciences evidence. The most pertinent ethnographic data were obtained by Boma Johnson and Jay von Werlhof from a Yuman-speaking informant in the Colorado Desert. Johnson (1985, 37) notes that an individual seeking power in a vision quest often 'would break up white quartz rocks, believing that the high spiritual power contained within these would be released to enter his or her body'. Their informant was able to identify certain vision quest locales from the scatter of white quartz rocks that surrounded them (von Werlhof pers. comm. 1996). As should then be clear, the scatter of flaked but otherwise unmodified or unused quartz rocks at Sally's Rockshelter, especially the concentration of them in the upper soil depression at the top of the site, may be interpreted as a scatter resulting from the practice of breaking quartz during vision quests.

The reason for this belief — that the breaking of quartz rocks releases supernatural power — is partly explained by Southwestern ethnography, where the ritual use of 'lightning stones' is well-documented (e.g. Jeancon 1923; Kidder 1932, 93–4; Hewett 1945, 32–3; Stalling & Stubbs 1953, 121; Reichard 1977, 93–4, 212). These are quartz rocks that, when rubbed together, generate a bright, lightning-like flash of light. Quartz rocks were used to ritually generate light which, in the Native Californian case, was perceived as a manifestation of supernatural power.

Physical studies of quartz corroborate and explain these ethnographic observations and practices. In 1880 Pierre and Jacques Curie discovered that certain crystals, especially quartz, produce electrical voltage known as piezoelectricity ('pressure electricity') when subjected to pressure, thus translating mechanical force into electrical energy (Cady 1964). (Quartzite is also piezoelectric, because it is composed of quartz grains, but less efficiently so.) This discovery has had a profound influence on technological innovation over the last century (Bottom 1981), even if it is widely unrecognized outside electrical engineering. The piezoelectrical effect has allowed the development of electromechanical transducers (used in microphones, phonograph pick-ups, ultrasonic generators, etc.) and resonators. Quartz crystal resonators are the basis for frequency control in oscillators and electrical wave (frequency separation) filters. These two kinds of controls have been crucial for the development of radio and television broad-

casting, and of telephone systems (Lewis 1987, 505). The power of quartz literally is the basis for modern communication systems — a circumstance well-demonstrated by the argument that quartz should be retained in the U.S. National Defense Stockpile (Bottom 1981).

A by-product of piezoelectricity is triboluminescence. This is a photon flash caused by electrons in the quartz atoms that have been ejected by gamma radiation penetrating crystal lattice defects. A small mechanical shock allows these electrons to overcome their energy barrier and to cascade down to ground state, giving off a glow as they return to their atomic orbit (Bailey 1992; Weisstein 1996). (This is easily illustrated by striking or rubbing two quartz rocks together in a dark room; the effect is also easily achieved with a number of other crystals. Quartzite can also result in triboluminescence but, in our experiments, a visible glow is much harder to achieve, and the environment has to be pitch-black for it to be visible. Other common rocks in the Mojave Desert, like basalts, sandstones and grano-diorite, are not triboluminescent.)

In accordance with physical laws, a true generation of power occurs when quartz rocks are struck or rubbed together, a power that is manifest in a cold, luminescent glow. It is this triboluminescence that was generated by lightning stones in Southwestern kiva rituals, and by Native Californian shamans who 'broke up' white quartz rocks on vision quests. Quartz was used as a rock engraving hammerstone, then, because it, like the image it was used to create, contained visible power.

The widespread belief that quartz rocks contained power was, in the physical sense, perfectly correct, although we might choose to see this power as a manifestation of physical properties and laws rather than supernatural qualities. Still, it is clear that the underlying belief about quartz and its consequent ritual use were not irrational nor epiphenomenal. They were, instead, a result of careful observations of real physical properties in the natural world, with the association between quartz and shamans then logically following. Triboluminescence provided the natural model upon which widespread shamanistic beliefs about quartz and other crystals were based.

### Antiquity of the vision quest

Our final question concerns the antiquity of the shamanistic vision quest in the Mojave Desert: how far back into time was this ritual practised and, by im-



plication, how old is this shamanistic religion? For many archaeologists this might seem an insoluble problem, because they view religious practices as epiphenomenal. Yet as is now clear, ritual behaviour may be as obvious in the archaeological record as technology, economics and adaptation. Determining the antiquity of the ethnohistorically-identified vision quest and the religious beliefs associated with it becomes an empirical problem that is conceptually and methodologically no different from any other use of the Direct-Historical Approach in archaeology (Huffman 1986), especially given that belief systems are widely recognized as the most conservative aspects of culture (Bloch 1974). Resolving this problem is primarily a question of identifying the archaeologically observable attributes of the vision quest during the ethnographic period, and determining the time-depth of the systematic association of these attributes. The argument is strengthened when the beliefs and ritual practices in question are linked to natural models that, based on physical laws and uniformitarian principles, have not themselves changed over time.

A series of archaeologically observable attributes are systematically associated with Numic shamanism. Principle among these are: the making of rock engravings during the vision quest; the use of a specific iconographic corpus for these engravings; and the ritual association of quartz with the vision quest. Continuity in each of these empirical attributes is matched by a fourth: continuity in site use over time. We discuss each of these empirical lines of evidence in turn.

#### (1) *Continuity in the making of rock engravings*

Our knowledge of the antiquity of rock art in the Mojave Desert is primarily based on experimental CR dating (see Dorn & Whitley 1983; 1984; Whitley & Dorn 1987; 1988; 1993; Whitley *et al.* 1996; W&S Consultants 1996a,b; 1997). This suggests that rock art was first made during the Late Pleistocene, and that it continued through the Holocene. While these CR ages are admittedly controversial, independent standard radiocarbon dating of stratigraphic deposits covering buried motifs indicates that rock engravings and paintings were made in the far west at least as early as 7000 BP (e.g. Thomas & Thomas 1972; Randolph & Dahlstrom 1977; Cannon & Ricks 1986). This independent evidence places rock art production by at least the early Holocene. Furthermore, a number of depictions of extinct Pleistocene megafauna have now been reported in western North American rock art (Agenbroad 1994). These include

a possible North American llama rock engraving in the Rodman Mountains, Mojave Desert, which is CR dated to 12,500±2000 YBP (W&S Consultants 1996b; Whitley 1999b). Varnish microlamination studies (Liu & Dorn 1996) confirm that revarnishing began on this rock engraving at least 10,000 years ago. Robert Reynolds, a palaeontologist at the San Bernardino County Museum, recently examined a photo of this engraving and confirmed that its most likely identification is a species of extinct, Pleistocene llama (R. Reynolds pers. comm. 1997). These circumstances support the general plausibility of our early CR ages. Moreover, comparisons of experimental CR ages with standard radiocarbon assays derived from sediments overlying rock engravings, and with other temporal constraints, have yielded close agreements (see Loendorf 1991; Francis *et al.* 1993; Francis 1994; Faris 1995). This provides further justification for accepting the experimental CR ages as reasonable estimates of the true ages of the rock engraving, indicating a ritual tradition over 10,000 years old in the Mojave Desert.

#### (2) *Continuity in rock art iconography*

The age of the Mojave petroglyphs is an important aspect of the empirical evidence for the antiquity of vision-questing. It is, however, necessary but not sufficient evidence, inasmuch as the reason for making the art could have changed over time. Thus, information on the age of the art, and its continuity, must be matched against independent lines of evidence.

The first of the independent lines of evidence is the iconography of the art. This is a critical clue to any continuity in ritual and belief because changes in religious systems should be manifest in their attendant symbolism. Moreover, iconography is particularly important in the current case given that the forms of motifs originating in the ethnographically-documented shamanistic vision quests have been linked to a series of very specific neuropsychological attributes of ASC imagery. These are: (i) the portrayal of entoptic patterns; (ii) the construal of entoptics as iconic images; (iii) the mixture of iconic and entoptic motifs in a single assemblage; (iv) the perception of mental images in a variety of forms and configurations; and (v) the depiction of the somatosensory and emotional effects of ASC — specifically, the depiction of a series of trance metaphors, including death, killing, transmogrification, aggression and flight — all combined into a single corpus of art (Lewis-Williams & Dowson 1988; 1989; Lewis-Williams 1991; Whitley 1994a,b; 1998a; in press a).

That these characteristics of shamanistic imagery derive from uniformitarian principles greatly strengthens any inferences based on a systematic association of them in a single corpus of art.

At this stage our chronometric investigations are insufficient to evaluate all the temporal dimensions of each of these iconographic attributes of shamanistic motifs. However, the dating research is sufficiently detailed to suggest that the mixture of iconic and entoptic images in a single corpus extends back throughout the temporal sequence (see Whitley & Dorn 1988; W&S Consultants 1996a,b; 1997). This contention is independently supported by Grant (1968, 16–17) who, from an examination of relative revarnishing in the Coso Range, argued that 'naturalistic', 'stylized' and 'abstract' motifs (as he termed the different classes of engravings) co-occurred throughout the production of Coso engravings.

Furthermore, while we have identified changes over time in the relative frequencies of certain of these motifs, specifically a proliferation of bighorn and anthropomorph engravings during the last 1000–1500 years (Whitley 1994c, 361; W&S Consultants 1996a; 1997), our dating research suggests that the primary iconographic components of the Mojave Desert rock art — entoptics and bighorns — co-occur from the Late Pleistocene (Whitley & Dorn 1988; 1993; Whitley *et al.* 1996; W&S Consultants 1996a,b; 1997). Iconographic changes, then, do occur over time in this art, and these changes probably reflect shifts in its specific symbolic emphasis and ideological function. But these are quantitative shifts within a preexisting corpus of motifs, not the replacement of one iconographic system by another. They provide no empirical evidence suggesting that the origin of the art in shamanistic vision-questing itself changed over time.

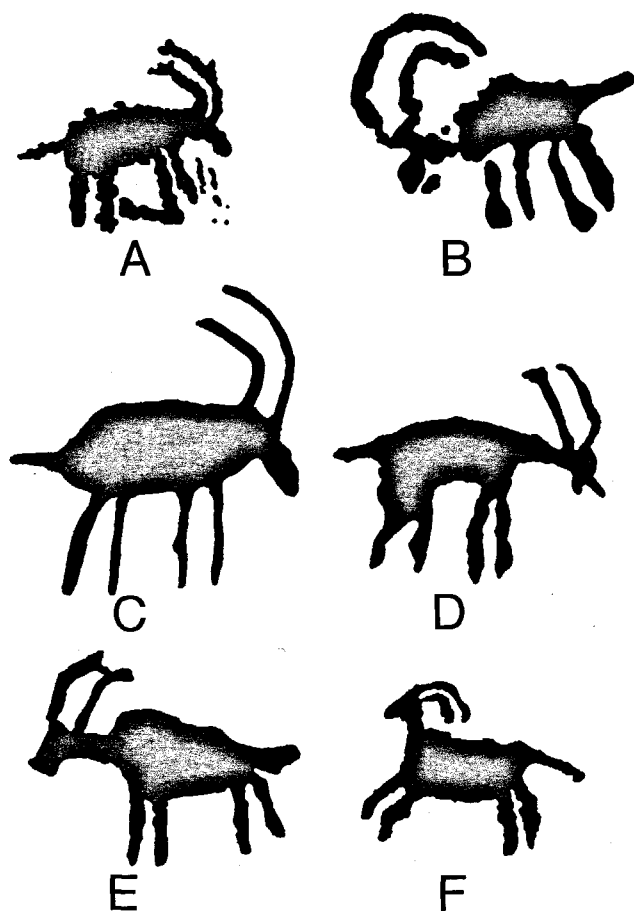
The examination of the earliest-dated iconic motif, bighorn sheep, reveals three key iconographic attributes that were used continuously throughout the temporal sequence. These attributes demonstrate intentional iconographic continuity and serve to link the motifs to vision quest imagery and symbolism. They are: dramatically curved horns; upraised tails; and anatomically-impossible depictions of the heads and horns, with the horns portrayed as two parallel curved lines rising above a head and body otherwise shown in profile (Fig. 7; see also Whitley 1994c, pl. 1a; Whitley & Dorn 1988, fig. 3a, d). Julian Steward (1929, 187) first noted that the majority of the bighorn engravings in the far west depict the massive curving horns of the adult male ram. They are so

identifiable because the bighorn is neoteness, with the fully mature female ewe retaining throughout life the much smaller horns that are also common to the juvenile male (Geist 1971, 13; Hansen & Deming 1980). From the Late Pleistocene, then, the iconography systematically and specifically portrays adult male bighorn sheep, not simply bighorns of any age or sex.

Steward (1929) was also the first to note that the majority of the bighorns are portrayed with an exaggerated and relatively unnatural tail posture: enlarged and upraised. A tabulation of tail depictions and postures in about 400 Coso Range bighorn engravings indicates that approximately 90 per cent display this iconographic convention. Discussions with wildlife biologists indicate that, unlike other large mammals, male bighorns normally only raise their tails while defecating and upon death (Steve Stoney pers. comm. 1997). Inasmuch as the 'death of a bighorn' was a key verbal and graphic metaphor for the shaman's trance during the ethnographic period (Whitley 1994a, 14–15; 1994c; 1998a), it is plausible if not probable that the upraised and exaggerated bighorn tail, seen throughout the temporal sequence, was a continuous graphical reference to this trance metaphor, which is itself founded on the somatosensory and emotional effects of ASC linked to behavioural and biological traits of the bighorn.

The construal of a common entoptic pattern, nested or catenary curves (see Lewis-Williams & Dowson 1988), as an iconic form — the curving horns of the ram — is the final iconographic convention repeated in the Mojave Desert corpus that we have so far identified. In this case a characteristic of the mental imagery of trance is displayed in the engravings from the Late Pleistocene onwards, even though the resulting bighorn depiction is anatomically impossible, and even though other graphical conventions could just as easily have been used to portray the sheep.

Rock engravings from the Mojave Desert, in other words, show no evidence for the replacement of one iconographic corpus by another over time, as would be expected in a change from one religious system to another. Instead, the corpus displays a systematic continuity in the mix of iconic and entoptic motifs, in the construal of a specific entoptic as an equally specific iconic form, in the emphasis in the iconic imagery on bighorn sheep, and in a series of very specific iconographic details used to portray the bighorn, one of which may be linked to a key metaphor for the shaman's visionary experience.



**Figure 7.** Rock engravings of bighorn sheep from the Coso Range, Mojave Desert. All display three key iconographic attributes that are present in the corpus from the Late Pleistocene into the Numic period: (1) large curved horns of an adult male ram; (2) an exaggerated and upraised tail posture, which occurs at the death of a bighorn; and (3) an anatomically impossible head, with a profile view snout and horns construed from catenary curves. The tail posture is an iconographic reference to the death metaphor for the shaman's vision; the construal of catenary curves as horns is characteristic of the mental imagery of trance. In addition to these examples, similar engravings with no visible evidence for revarnishing are common, including examples on panels with historical motifs, suggesting the duplication of these iconographic features into the ethnographic period.

a. Engraving CM-12: CR age  $16,500 \pm 1000$  YBP.

b. Engraving CM-7: CR age  $11,200 \pm 1200$  YBP.

c. Engraving CM-3: CR age  $6800 \pm 700$  YBP.

d. Engraving CM-1: CR age  $4300 \pm 2100$  YBP.

e. Engraving CM-13: CR age  $1900 \pm 200$  YBP.

f. Engraving WP-2: CR age  $1100 \pm 200$  YBP.

Note that b, c and e all have evidence of quartz grains in the matrix; the others were not examined for foreign materials. Scales vary, but ~25–33 per cent.

### (3) Continuity in the ritual association of quartz with rock art

The use and association of quartz in the making of rock engravings, discussed above, is an inferentially important attribute of the vision quest because the use of quartz was tied to triboluminescence, a physical property that is timeless. The evidence of quartz grains in revarnished rock engravings, as remnants of hammerstones, suggests that a continuity in this very specific ritual practice and association extended back into the Late Pleistocene.

### (4) Continuity in site use

The final attribute of the Mojave Desert archaeological record that argues in favour of a continuous religious tradition extending back to the Late Pleistocene is continuity in use of rock-engraving sites. Significant changes in the rituals and beliefs that produced rock art can be expected to result in changes in the production of the art, including the locations where such ritual art was created. Rock engraving CR ages from the Coso Range, Cima Volcanic Field and Rodman Mountains suggest that most Mojave sites continued to be used for rock engraving throughout

the Holocene (Whitley & Dorn 1987; 1988; W&S Consultants 1996b). In addition, the inference that considerable time-depth in rock engraving occurred at many sites is evident in the great variability in the degree of revarnishing visible in the rock engravings. While revarnishing is a complicated natural process that is dependent on a number of microenvironmental factors, and even while the visible effects of revarnishing cannot be calibrated in any rigorous way, it is nonetheless obvious that substantial time-depth is represented at many Mojave Desert sites, as well as at other sites in the western Great Basin (e.g. Grant 1968; Woody 1996). Thus, no significant change in the rock art-producing ritual, as might be implied by changes in rock art site location and use, can be inferred.

These four lines of evidence support the interpretation that shamanistic vision questing is 10,000 or more years old in the far west. The continuities in the iconography and manufacturing process are particularly important, in our opinion, because the beliefs and behaviours underlying them are based on physical laws and uniformitarian properties that have not changed during the human occupation of the

earth. The sum of this evidence is that this practice of shamanistic vision-questing is the oldest and longest-lived religious tradition empirically identified so far in the world. This conclusion supports the speculations of anthropologists and archaeologists who have argued for almost a century that shamanism may have been the original religion of the first inhabitants of the western hemisphere (e.g. Kroeber 1923, 349; Furst 1977, 20; von Gernet 1993).

Critics of the Direct-Historical Approach in archaeology might contend that the exercise outlined above is nothing more than a transposition of the recent ethnographic past onto the prehistoric record. Why bother with archaeology, many of us were taught during the 1960s and 1970s, if our approach to studying it reduces to nothing more than a restatement of the ethnography? Yet as Huffman (1996) has shown, the combination of ethnographic and archaeological data in the Direct-Historical Approach can literally result in the rewriting of aspects of the ethnographic record. The importance of quartz hammerstones to the making of rock engravings — a fact missed by all ethnographers — is one small example of Huffman's observation.

#### Apparently irrational beliefs

Since Descartes, western thinking has maintained that science is logical and rational, whereas religious systems are irrational and illogical. This has contributed to the archaeological perception that prehistoric belief systems cannot be reconstructed, and/or that they are irrelevant and can be analytically ignored, in part because they are epiphenomenal. Yet as we have shown here, at least some of the beliefs that are archaeologically visible in ritual remains are ultimately based on natural models that are as logical and coherent as our own western scientific thinking. The recognition of this fact has allowed us empirically to identify the oldest continuously practised religious tradition known in the world.

Meanwhile, American archaeology is suffering from the effects of NAGPRA which, owing to Native American religious beliefs, is stripping the discipline of many of its most treasured scientific collections. This leads us to pose the obvious question. Which is the irrational belief: the idea that beliefs have material effect and are worthy of archaeological study? Or the opinion that religion, symbolism and belief are irrational and irrelevant to archaeological science? NAGPRA has shown that the future of archaeology in the U.S. as a scientific and academic discipline is inextricably bound up with this question.

#### Notes

1. A controversy has recently developed over dating of rock engravings. Members of the University of Arizona Accelerator Radiocarbon Group have accused one of the co-authors of this paper of submitting contaminated varnish samples for AMS radiocarbon dating (Beck *et al.* 1998; Dorn 1998). This is not the place to respond to this controversy, partly because chronometric dating is only a peripheral issue to the subject at hand, partly because the accusation of scientific misconduct against Dorn has been fully investigated and he has been officially exonerated, but primarily because the controversy involves radiocarbon varnish dating and not the CR varnish dating used here. We therefore emphasize that these are CR ages, not varnish radiocarbon ages, and the previous controversy does not concern them. Furthermore, the CR ages have been recalibrated on new CR curves for the central Mojave Desert and the Coso Range that eliminate all varnish radiocarbon ages (see W&S Consultants 1997), using instead only cosmogenic and conventional radiocarbon assays.
2. Sometimes this fact was expressed metaphorically by stating that the art was made by a spirit helper. This reflected the belief that the actions of a shaman and his helper were indistinguishable (Gayton 1948, 32; Applegate 1978, 27; Siskin 1983, 22). It also obviated an important cultural problem posed by the ethnographer's question. A metaphoric response avoided the widespread taboo of naming a dead person which might have been required by a direct response to the query, 'Who made this rock art?', as Laird (1984, 302) has observed.
3. The reason for the small and seemingly insignificant nature of the offerings — contrasting with our own cultural view which would favour expensive and elaborate ritual gifts — is perfectly logical in light of far western North American beliefs about the nature of the supernatural, and ritual practices during the vision quest. The vision quest involved numerous symbolic inversions, and the supernatural was thought the perfect opposite of the natural (Applegate 1978, 38–9; Whitley 1999). Hence a seemingly mundane and inconsequential offering in the natural world would correspond to a lavish gift once received by a spirit in the supernatural.

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