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Rock-art image in Fern Cave, Lava Beds National Monument, California: not the AD 1054 (Crab Nebula) supernova

R.A. ARMITAGE, M. HYMAN, J. SOUTHON, C. BARAT & M.W. ROWE*

The visual manifestation of the recent Hale-Bopp comet reminds us how telling are those rare objects which suddenly flare in the sky. One can suppose ancient people living by natural light were more compellingly struck by the sight of comets and supernovae, and understandably researchers seek images of them in the shapes of rock-art motifs. An absolute dating contradicts that supposition in respect of a presumed image of the visible supernova of AD 1054.

On 4 July AD 1054 a supernova brighter than Venus appeared in the sky, remaining visible for approximately 23 days and 650 nights. It was chronicled in five independent historic accounts, four from China and one from Japan (Duyvenduk 1942). Hubble (1928) suggested that the Crab Nebula is a result of the AD 1054 event, a view generally accepted (Clark & Stephenson 1977). For at least 40 years investigators have attributed certain distinctive rock paintings and carvings in the western United States as recordings of the AD 1054 supernova. More than 20 such depictions (circle or star-like symbols and a crescent) have been located (Brandt & Williamson 1979). In particular, two panels of rock paintings in Lava Beds National Monument, California (FIGURE 1), one at Fern Cave and one at Symbol Bridge, were listed as recording the AD 1054 supernova. Brandt *et al.* (1975: 52), noting that the orientation of the moon and su-

* Armitage, Hyman & Rowe, Department of Chemistry, Texas A&M University, College Station TX 77843, USA. E-mails: raa6112@acs.tamu.edu hyman@chemvx.tamu.edu rowe@chemvx.tamu
Southon, Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Livermore CA 94551, USA. E-mail: john.southon@quickmail.LLNL.gov
Barat, Lava Beds National Monument, Tule Lake CA 96134, USA. E-mail: labe_administration@nps.gov

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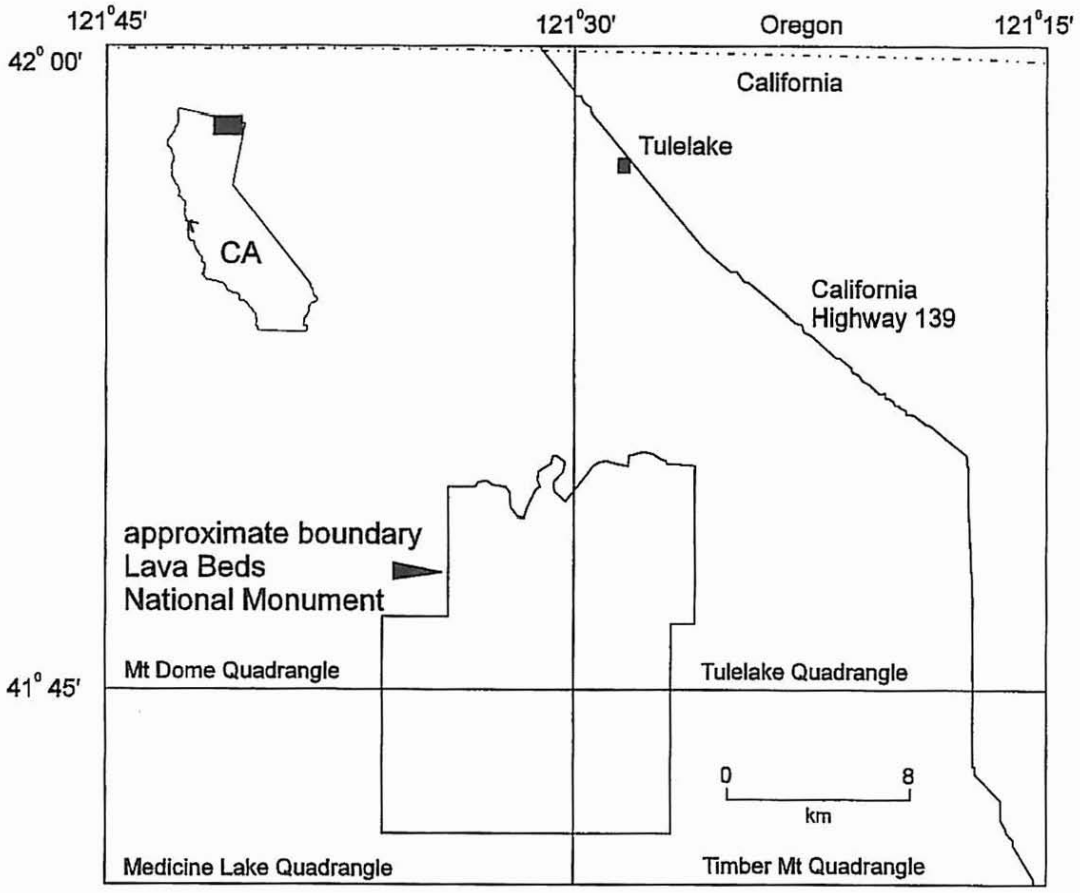

FIGURE 1. *Location of the Lava Beds National Monument, California.*

pernova are not correct in the Fern Cave rock painting, concluded that 'errors in recording the orientation of the crescent moon are common'. The only direct means of assessing the likelihood that a 'supernova' representation records the AD 1054 event is to date the rock painting or carving. In our laboratory at Texas A&M University, we developed a plasma-chemical extraction technique that permits analysis of ^{14}C in rock paintings, whether the pigments used were charcoal or inorganic iron- and manganese- oxides and hydroxides with organic binder/vehicles (Ilger *et al.* 1996). This paper presents direct ^{14}C age estimates on rock paintings that have been suggested to represent the AD 1054 supernova. The AMS ^{14}C analysis on each sample using our plasma-chemical extraction technique shows that these images do not represent the AD 1054 supernova.

Experimental procedure

We took charcoal pigment samples from three figures in proximity at Fern Cave: a crescent pointing downward and two near-by circles, one above and one below the crescent (FIGURE 2). Small amounts of charcoal were scraped from the crescent and two circles individually. Rubber gloves were worn to avoid contamination during sampling and all subsequent handling. Each charcoal sample was placed on aluminium foil, wrapped, and sealed in a plastic bag. The motif was photographed before and after sample collection. Damage incurred to the three paintings was so small that it was difficult to determine by visual inspection where the sample was removed.

The samples were treated with 1 M NaOH and sonicated at 50°C, a standard procedure used to remove possible humic and fulvic acids that might contaminate the charcoal to be

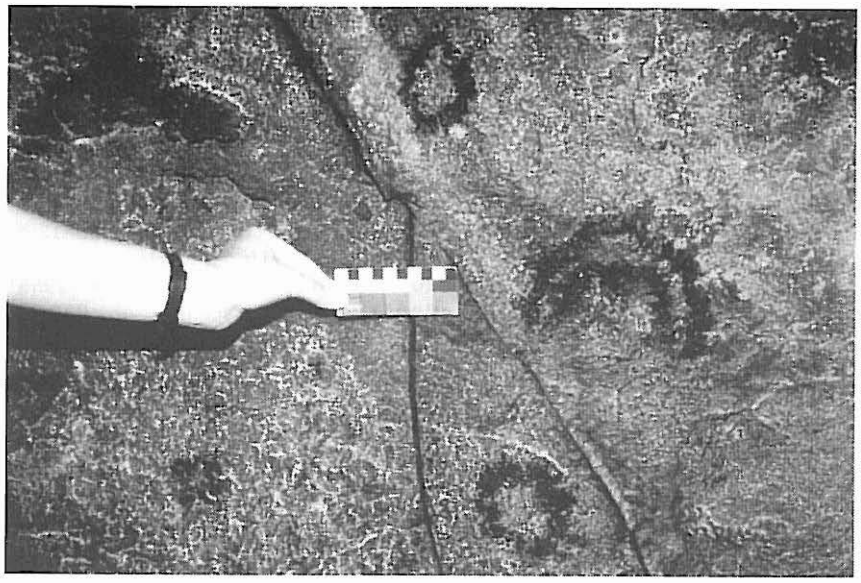

FIGURE 2. *The rock art panel showing two circles to the left of a crescent, an image that has been suggested as a recording of the* AD *1054 supernova explosion. The scale is 10 cm long.*

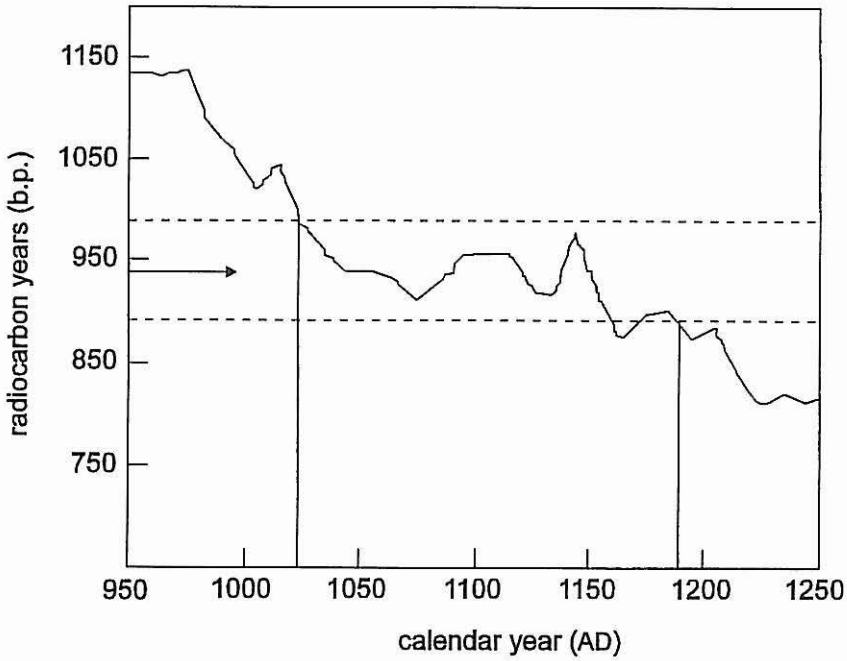

FIGURE 3. *Radiocarbon calibration curve in the vicinity of* AD *1054. The* ^{14}C *date corresponding most closely with* AD *1054 (938* ^{14}C *years b.p.) lies within the* $\pm 1\sigma$ *uncertainty band of the calibration curve for calibrated ages from* AD *1030–1160. (Stuiver & Reimer 1993).*

analysed for ^{14}C. Humic and fulvic acids are brownish-yellow in NaOH. It took 8–10 one-hour treatments with NaOH before the solutions appeared clear; we then did three additional extractions to ensure complete removal of the humic and fulvic acid components. Neutralization of the NaOH solutions with 1 M HCl produced no humic acid precipitate; thus the brownish colour was likely due to fulvic acids. The NaOH-treated charcoal samples were then rinsed with doubly distilled, de-ionised water, filtered and dried; they were then ready for plasma-chemical extraction of the organic carbon for ^{14}C analysis.

In preparation for the extraction, we use radio-frequency generated, low-temperature (<175°) oxygen plasmas to remove organic

material as CO_2 from the empty reaction chamber. Argon plasmas are used on the sample after its insertion into the chamber to remove adsorbed CO_2 from the system. Finally, oxygen plasmas are utilized on the paint sample to convert the organic carbon to CO_2, leaving the substrate rock and accretion carbonates and oxalates intact. This organic carbon is then analysed by AMS. Experimental details, reported in our previous paper (Ilger *et al.* 1996), are not repeated here. Since the introduction of our plasma-chemical technique in 1990, we have demonstrated its validity on numerous samples of known ^{14}C content: charcoal (two dated previously by Beta Analytic, Inc. and one dated previously at the University of Texas Radiocarbon Laboratory), Third International Radiocarbon Intercomparison wood and African Ostrich shell (dated at the University of Arizona). Satisfactory agreement was observed in all cases. Our analyses of ^{14}C-free samples — Albertite, IAEA wood and Axel Heiberg wood — demonstrated that our technique does not add significantly to the modern carbon background of the AMS. The following have also been studied and do not affect our ability to estimate the age of rock paintings by ^{14}C analysis: argon and oxygen sources; mass fractionation; calcium carbonate, magnesium carbonate, limestone, and calcium oxalate decompositions. The ^{14}C determinations we obtained on rock paintings from France, Montana, Texas and Utah are consistent with the age ranges expected from archaeological inference.

We used oxygen plasmas coupled with high vacuum techniques to remove organic carbon from the charcoal paint of each Fern Cave sample: the two circles and a crescent shown in FIGURE 2. The CO_2 produced was collected by freezing in a liquid-nitrogen cooled glass-finger. Radiocarbon contents of the samples were measured at the Center for Accelerator Mass Spectrometry of the Lawrence Livermore National Laboratory.

Results and discussion

Radiocarbon determinations and calibrated calendar dates are shown in TABLE 1 (Stuiver & Reimer 1993). Attempts to verify the validity of rock paintings as representations of the AD 1054 supernova are limited by the nature and uncertainty of the radiocarbon calibration curve in the critical area. The ^{14}C determination that most closely corresponds to the calendar date AD 1054 is 938 ^{14}C years before present (b.p.). FIGURE 3 illustrates that 938 years b.p. lies within the $\pm1\sigma$ uncertainty band of the calibration curve for calibrated ages from AD 1030–1160. Even if one could measure the ^{14}C content with perfect accuracy and infinite precision, it would not be possible to limit the calendar age of a rock painting painted in AD 1054 to better than this 130-year range: there is no way to determine which is the 'true' date. Nonetheless, analysing ^{14}C from the rock paintings directly is the only way to affirm or deny that they are consistent with their assignment as representing the AD 1054 supernova. A ^{14}C content consistent with AD 1054 does not prove that a depiction *is* of the supernova; ^{14}C determinations not consistent with AD 1054 (within experimental uncertainty) effectively rule out an image as recording the supernova.

sample	weight of carbon, μg	laboratory number	uncalibrated determination, b.p. ±1σ uncertainty	calibrated AD ±2σ uncertainty
Lower circle	250	CAMS-27229	840±70	1020–1290
Upper circle	185	CAMS-27860	230±70	1490–1955*
Crescent	230	CAMS-27861	330±50	1440–1670

* 1955 denotes the influence of bomb ^{14}C.

TABLE 1. *Radiocarbon determinations and calibrated calendar dates (Stuiver & Reimer 1993) for the three Fern Caves rock art images: two circles and a crescent.*

For the Fern Cave samples, the lower circle, calibrated at AD 1020–1290 ($\pm2\sigma$ range) is distinctly older than both the upper circle, at AD 1490–1955, and the crescent, at AD 1440–1670. Radiocarbon determinations on the upper circle and crescent are not significantly different from one another; they may have been painted contemporaneously. Both features date from several centuries after the AD 1054 supernova. There were no discernible differences in terms of colour or other visual features between the three figures studied here. The ^{14}C contents of the three figures of the painted panel demonstrate conclusively that it does not represent the AD 1054 supernova.

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Spinning or sailing?: the boat models from Eridu

JANINE BOURRIAU & JOAN OATES*

More on whether the prehistoric pottery vessels from Eridu, in Mesopotamia, are models of precocious boats, or as was argued in a recent ANTIQUITY, spinning bowls.

A sceptical view of received wisdom is much to be encouraged, and in that sense we welcome Thomas Strasser's reinterpretation, in the December ANTIQUITY, of the so-called boat models from Eridu. There are, however, strong arguments for rejecting his spinning bowl hypothesis. The known spinning bowls from Egypt and Palestine are massive and heavy, in order to provide tension against which to pull and ply or twist the fibres being prepared. (Technically these bowls are not for spinning *per se*: Barber 1992: 72.) They must be sufficiently stable to stay in place and not overturn. Barber suggests that they are also used for 'wetting' and that these bowls were associated specifically with the production of linen (Barber 1992: 72). The eastern Mediterranean examples have *heavy* handle-like loops within the base which show thread wear on the undersides. The Eridu vessels are far too fragile for such usage and the Eridu 'thwart' is not sufficiently heavy to have survived the necessary tension: nor would the boat-shape itself have been stable (see illustration in Safar *et al.* 1981: 227). Strasser also suggests — on the model of Aztec spinning bowls — that the socket, preserved in one of the boats and previously assumed to have held a mast, in fact held a rotating spindle from which the thread was drawn. However, the surviving socket is off-centre, which would have produced an unreliable wobble, as would the shape of the vessel itself.

The Eridu 'boats' date from the early 5th millennium BC, a time when no spinning bowls are attested anywhere. They are found, moreover, within a culture in which yarn and thread are traditionally produced by the use of hand-held spindles (widespread by the time of the Neolithic villages of the 7th millennium BC and more suitable for wool). Unlike Egypt, no spinning bowls are illustrated even in later periods, nor have they been found, whereas the use of hand-held spindles continues (for example, the 3rd-millennium BC spinning ladies of Mari:

* McDonald Institute for Archaeological Research, Downing Street, Cambridge CB2 3ER, England.

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Parrot 1962: plate 11). The only Mesopotamian bowls with 'inner handles' are a small number, largely from the Early Dynastic period, with interior clay 'flaps', originating at the rim and usually isolating a central area in the bowl. Their purpose is not clear; the three- and four-flapped varieties have been interpreted as pot-stands, possibly for collecting seepage from the supported vessel (*cf.*, *inter alia*, Abu Salabikh: Moon 1987: 43; the Nuzi 'goose neck potstand': Starr 1937: plate 95B; Tepe Gawra Level IV: Speiser 1935: plate 29b; and the massive single-strap example from Habuba Kabira Süd: Strommenger 1970: figure 24). These show no sign of having served as spinning bowls, nor would their design have been efficient for such a purpose (see now Allen in press). In the eastern Mediterranean the earliest spinning bowl would appear to be that from Myrtos, illustrated by Strasser (Early Bronze Age): such vessels are not attested in Egypt before the Middle Bronze Age (12th Dynasty, with a single model dating to the 11th Dynasty), and appear later still in Palestine. Strasser suggests that the boat interpretation is 'precocious' and 'incongruously early'; the same can be said of the spinning bowl hypothesis.

Nor has Strasser read carefully the Roaf & Galbraith article (1994) which is said to 'cast doubt on' the neutron activation analyses of 'Ubaid pottery from sites along the Arabian Gulf with which the Eridu boats have been coupled. Roaf & Galbraith suggest more sophisticated statistical techniques and point out several regrettable errors, the most serious of which involves the attribution of the same data to two sites. The original computer data are now lost, but the first print-out, at which time only the Arabian sherds had been analysed, shows these data to be correctly attributed to the Arabian site of Dosariyah, so it is the Eridu results that should be ignored (Oates *et al.* 1977: 226–7 and figure 2; Roaf & Galbraith 1994: 773). This unfortunate error in no way invalidates the overall results which are further supported by Kamilli's thin-section data. Indeed it serves to emphasize the similarity of 'Ubaid pottery from the Gulf and from southern Mesopotamia. Moreover, Roaf & Galbraith conclude that their study 'supports the two main conclusions of SMU [Oates *et al.* 1977]: some (or indeed most) of the Ubaid pottery found in the Gulf could have been imported from southern Mesopotamia; the coarse red ware . . . is very different and may have been produced locally' (Roaf & Galbraith 1994: 778). Recent archaeological work in the Gulf continues to demonstrate the maritime distribution of the 'Ubaid pottery (see, most recently, Uerpmann & Uerpmann 1996, which publishes 'Ubaid-related sites as far south as Umm al Qaiwain). The fact that boat models from Mashnaqa on the River Khabur are of another, and better-known, design is irrelevant to the argument since such canoe-like vessels would have been suitable neither for carrying cargo nor for negotiating the vast stretches of open water in the Gulf, where access to drinking water is seriously limited. Technologically, the broad beam of the Eridu 'boats' would have provided not only space for cargo but also greater stability.

We are not insisting that the Eridu vessels must be sailing boats, though we see no strong argument to the contrary and the 'seafaring' activities of the 'Ubaid period remain securely attested, only that on closer examination the spinning bowl hypothesis would seem to be even less plausible. We are grateful to Strasser, however, for leading us to look more closely at the all-too-limited evidence for spinning techniques.

Thomas F. Strasser comments:*

Bourriau & Oates present several interesting observations that warrant a brief response.

First, it is not entirely clear to me why the Eridu vessels are not 'massive and heavy' enough to function as small domestic spinning bowls. Dothan (1963: figure 1) published several ceramic spinning bowls of the same size and even smaller. Second, not all spinning bowls had flat bottoms, so wobble must have been somehow managed, perhaps with a wedge (a piece of cloth?). Third, despite the definite evidence for spinning in the 'Ubaid levels at Eridu, the idea that contemporary spinning bowls would be just as precocious and incongruous as sailing boats is a valid criticism that reveals a point I failed to make in ANTIQUITY. There are more misinterpreted objects in the Neolithic and Bronze Age archaeological record that will need to be reinterpreted as accoutrements of textile

* Departments of Humanities & Religious Studies, and History, California State University (Sacramento), Sacramento CA 95819, USA.