ORIENTATION

Developing ICRAD

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Introduction

Professor Tang Huisheng's decision to establish the International Centre of Rock Art Dating and Conservation, publicly announced on 18 July 2014 at the IFRAO Congress in Guiyang City (Bednarik 2016), has led to its establishment at a ceremony at Hebei Normal University in Shijiazhuang on 16 June 2016. That university already possessed facilities for AMS radiocarbon, uranium-thorium and OSL analyses. The purpose of ICRAD is essentially twofold: the institute will conduct its own research in age estimation of rock art, building on the work already undertaken in China (Tang and Gao 2004; Tang and Mei 2008; Tang 2012; Tang et al. 2014, 2017; Anni et al. 2016); and it will establish a comprehensive archive for global information on all direct rock art dating projects and results. For the latter objective it needs extensive international collaboration (see p. 116).

Therefore the new facility, headed by Tang, is to become a world repository of all relevant results. This is a feasible goal because direct dating methodology was introduced only in the early 1980s, and an apparently comprehensive record of all results announced until 1995 has already been published (Bednarik 1997). Moreover, Rowe (2012) has provided a comprehensive record of all rock art age estimation work published in English until about 2011. Therefore this goal of securing a complete archive of all published work in direct rock art dating seems quite achievable, with the help of the international community of researchers working in this field.

'Direct dating' of rock art refers to the estimation of its age by direct physical relationship of the petroglyph or pictogram and the dating criterion, governed by testable (falsifiable) propositions concerning that relationship (Bednarik et al. 2010). It is therefore epistemologically different from traditional archaeological approaches of seeking to determine the age of rock art (for example through excavation, stylistic claims, iconography or technique), which refer to deductive reasoning regarding untestable assumptions. To illustrate with an example: concealment of rock art by a sediment does not always provide minimum 'direct dating', because the sediment stratum may not necessarily be of the same age as the dating criterion used, such as the radiocarbon age of some charcoal found in it. It follows that direct dating claims need to comply with the rigorous requirements of science. Science expects exacting predictions for future observations about phenomena that can be measured. The regularities within these phenomena must be described as consistent patterns, explained by refutable theories cast in terms of causes and effects. Modern science favours a normative epistemic relativism and demands specific procedures of refutation and repeatability of experiments: *repetitio est mater studiorum* (repetition is the mother of science). Normative epistemic relativism concedes the lack of framework-independent facts about general veracity, but preserves the veracity of inference, justification or rationality relative to specific frameworks.

Rendering rock art age estimation scientific

In applying these fundamental principles to the age estimation of rock art it is essential that the basis of any propositions be clearly defined. One of the difficulties in archaeology is that its principal method, excavation, does not yield scientific propositions about the past. This is not because these hypotheses are necessarily false, but because much of the evidence for them has to be destroyed in the process of securing it: the excavation of a specific parcel of sediment can only be performed once, and the observations made in the process cannot be falsified. Therefore their veracity needs to be accepted on the basis of authority, which in proper science is not satisfactory; *testability* is the principal criterion of a scientific proposition.

This defines a key prerequisite in direct dating of rock art. The records made in any determination must be presented in such a way that another researcher can try to duplicate (or refute) the reported results. There are two ways of testing propositions: either using the same method, or by an alternative method. To facilitate testing in the first case the dating criterion must be described in such a way that the second researcher can re-locate it reliably. In the second case, only the rock art motif needs to remain identifiable.

These rules have to govern the nature of the records that are to be provided for direct rock art age estimates. To illustrate the practical application of these tenets, the method of microerosion is considered because in its recent applications these factors have already been taken

care of. To check the results of this method is relatively easy, provided the analyst testing the claim can re-locate the micro-wane that was measured originally. To facilitate such re-location at any future time, even centuries from now, the following data are required:

1. The site location: this can be provided by recording coordinates or access description.
2. The individual petroglyph analysed: a photograph of the motif is required on which the sampling locality is marked.
3. The precise location of the micro-wane: a microphotograph indicating the location is preferably provided.
4. Measurement of the length of the micro-wane: this information provides confirmation for the analyst that the correct feature has been re-located.
5. Sketch of micro-wane and its context: facilitating re-location of the micro-wane in the topography where the context may be morphologically complex.
6. Measurements of wane widths along the micro-wane.

The application of this protocol is still in its infancy (but it has been applied; Tang et al. 2017; Santos et al. in prep.), yet its general extrapolation to all methods used in rock art age estimation is necessary to render this discipline fully scientific. Besides the need for testability, which is the core concept of science, there is another requirement. Petroglyphs are not ephemeral phenomena; they persist through the centuries and millennia, over timespans determined by the durability of the mineral in question and by the ambient environment. The only minerals so far used in microerosion analysis, quartz and feldspar, have the potential to permit the remeasuring of their micro-wanes over long periods. Such data can then in turn be used in refining the method, because the growth of the wanes as a function of time is the central criterion of the method. The rate of wane formation can be predicted, and one of the key features of science is the predictability of phenomena and processes.

Professor Tang Huisheng, Director of ICRAD, conducting field microscopy at Jiangjunya, Jinping Hill, Jiangsu Province of China, in 2014.

This example illustrates precisely why the recording of such analytical work needs to be standardised to a protocol that will stand the test of time, and will not need to be significantly modified in the future. The same underlying principles should be applied to all other direct dating work: it needs to be repeatable and its results have to be testable. Wherever possible, the prospects of applying the same or a similar method should be encouraged by providing the information required for such re-analysis. With some methods it will suffice to record the location that was sampled; with some, such as microerosion analysis, greater resolution is likely to be required. But the primary concern of the analyst must be that the information needed to test the initial result in the future is furnished in reporting such work.

The records of ICRAD

These principles need to be applied in the way the records of ICRAD are to be organised. To begin with, each and every direct dating attempt needs to be identified by a unique code, in much the same way as radiocarbon results are distinguished by a distinctive label. This certainly applies to all future work, but perhaps it can be extended to earlier dating attempts all the way back to 1981, once these have been catalogued by ICRAD. Such a system has already been introduced in the microerosion work of China and Brazil, beginning with the successful campaign in the former country in 2014 (Tang et al. 2014; 2017). It needs to be adopted universally, and for all methods defined as 'direct dating' of rock art. Without such a system the discipline is likely to be stifled by a growing mass of uncollated and incompatible data, and a great deal of valuable and time-consuming work may fail to reach its full potential.

The following numbering system has been adopted in the case of microerosion analyses. The unique code of each attempt begins with the name of the country the site is located in, followed by the name of the site and the number of the motif (sampled motifs are numbered consecutively, commencing with 1 for each site; a 'site' is defined as a concentration of rock art motifs separated from other such assemblages by a distance of 50 m or more in every direction). If two or more samples are determined from one motif, these are identified in alphabetical order, beginning with lower case 'a'. Next come two capital letters, either 'EQ' or 'EF'. They stand for 'erosion analysis of quartz' and 'erosion analysis of feldspar', respectively. The identification code then ends with the date of the initial analysis, in the order of day, month and year. For instance the second micro-wane measured on Petroglyph No. 3 of the Helanshan site complex in Ningxia Province, China, has the code 'China-Helanshan3b-EQ-6/7/2014'. This means that the micro-wane is on a fractured quartz crystal and the

initial micro-wane width measurements were taken on 6 July 2014.

Obviously this means that ICRAD also needs to establish a register of all the sites listed in its catalogue. The site register must contain information about the precise location of the sites, essential details of their nature, and of any publications relevant to the dating attempts. But whereas the direct dating register will be made available publicly, so that it is accessible to all researchers, the site register will be of restricted access. It is the policy of the International Federation of Rock Art Organisations (IFRAO) not to make rock art site locations publicly available because this would endanger them and expose them to uncontrolled visitation, which leads at least to degradation of the rock art, and sometimes to its destruction. However, the direct dating register can list the contact details of the person or agency responsible for the site in question, to whom applications of access need to be directed. It should also list publications relating to the specific dating attempts.

The ICRAD catalogue should later attempt to apply a similarly coded identification system to all direct rock art dating techniques, which would currently include radiocarbon analyses of carbonate (which could be identified by 'RCC'), oxalate ('RCO'), charcoal ('RCH'), organic matter ('RCOR') and ferromanganese accretions ('RCF'); and such methods as uranium-series analysis of carbonate ('UC') or ferromanganese deposits ('UF'); optically-stimulated luminescence ('OSL'); cosmogenic radiation products analysis ('CR'); lichenometric analysis ('LA') and so forth. These codes will have the considerable benefit of their potential to be used in digital searches of the catalogue. In other words, in the setting up of the catalogue, the nature of its potential uses in the future needs to be anticipated, so as to obviate the need for any future changes to the system.

Summary

Tang's establishment of ICRAD is a major achievement in the scientific study of rock art that is bound to enhance the effectiveness of the discipline. It is therefore important that the system of its global archive of direct dating work be designed anticipating future developments in the field and foreseeing the ways this resource will be utilised by the world's rock art scientists. It will need to comprise two registers: the catalogue of all rock art direct dating results, and the register of all sites featuring in it. The first catalogue will eventually be placed on the Internet, where any researcher can search its pages for customised information, such as the compilation of a list of rock art datings by method, by region, or by results — the three variables that are likely to be of the greatest interest to scholars. This catalogue will also need to feature a comprehensive bibliography of all publications that have ever appeared on the topic of the scientific dating of rock art.

The ICRAD catalogue needs to be organised by a unique numbering system, and the coding system established by microerosion dating projects conducted in China in 2014 and 2015 is suggested to provide a suitable structure. It lends itself to broadening to comprise all other scientific methods used in this pursuit — those applied in the past as well as those that can reasonably be expected to be developed in the future. The effect of this standardisation will be to outpace the reigning routine of opportunistic forays into rock art dating, which are often sensationalised, and to replace them with a systematic regime of data acquisition. It is obvious that such a well-organised data bank will bring order into chaos and help a good deal in assessing the performance of individual methods. It will very effectively facilitate the development of methods that are likely to thrive from taking such a broadly based approach. During the pioneering phase of any field, reference points tend to be isolated and somewhat exploratory; it is with the maturing of a discipline that more methodical practices become possible, and that systematic acquisition of knowledge occurs. In the field of rock art dating, ICRAD will usher in this phase.

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Call for support

It is evident from the above proposal to develop ICRAD (the International Centre of Rock Art Dating and Conservation), and to establish a comprehensive archive of global information on all direct rock art dating projects and results, that extensive international collaboration will be needed. This is a call for help, directed to those who have an interest in, or commitment to, the age estimation of rock art. Please support ICRAD by providing your lists of publications about direct rock art dating projects, your off-prints or PDFs of such papers, other relevant information, or your suggestions for improving the operation of ICRAD. Without broad international support the establishment of the archive of ICRAD would be very challenging, and we will all benefit from it becoming as comprehensive as possible. The ultimate goal is to provide the discipline with an all-inclusive, wide-ranging world archive of all published work in direct rock art dating.

Thank you for your support. Please send your contributions to:

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