Archaeol. Oceania 31 (1996) 214–215

Uncertainties in ^{14}C ages for petroglyphs from the Olary province, South Australia

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Abstract

This report explains why previously published ^{14}C dates for the Olary petroglyphs cannot be relied upon.

The purpose of this note is to present uncertainties regarding the reliability of radiocarbon results published in *Archaeology in Oceania* (Nobbs & Dorn 1993). The radiocarbon samples come from petroglyphs in the Olary Province of South Australia. Some samples came from underneath coatings of manganiferous rock varnish, but on top of the underlying rock. In this interface position, I found material that resembles charcoal (Nobbs & Dorn 1993). Weathering-rind organics (Bonani *et al.* 1988; Krumbein & Dyer 1985; Viles 1995) were also dated.

Major uncertainties surround these previously published ages (Nobbs & Dorn 1993). First, varnish coatings can grow and erode at different places on a rock surface at different rates (Cremaschi 1996; Dorn & Oberlander 1982; Dragovich 1984; 1993; 1994), leading to open systems whereby younger organics can be added over time. Research in Portugal demonstrates that younger organics are introduced into petroglyph panels (Dorn 1997; Phillips *et al.* 1997).

Second, different fractions of organics extracted from the same position in Portugal yielded different ages (Dorn 1997); this problem may well occur in the South Australian samples where research had already established the heterogeneous nature of the organic matter (Nobbs & Dorn 1993).

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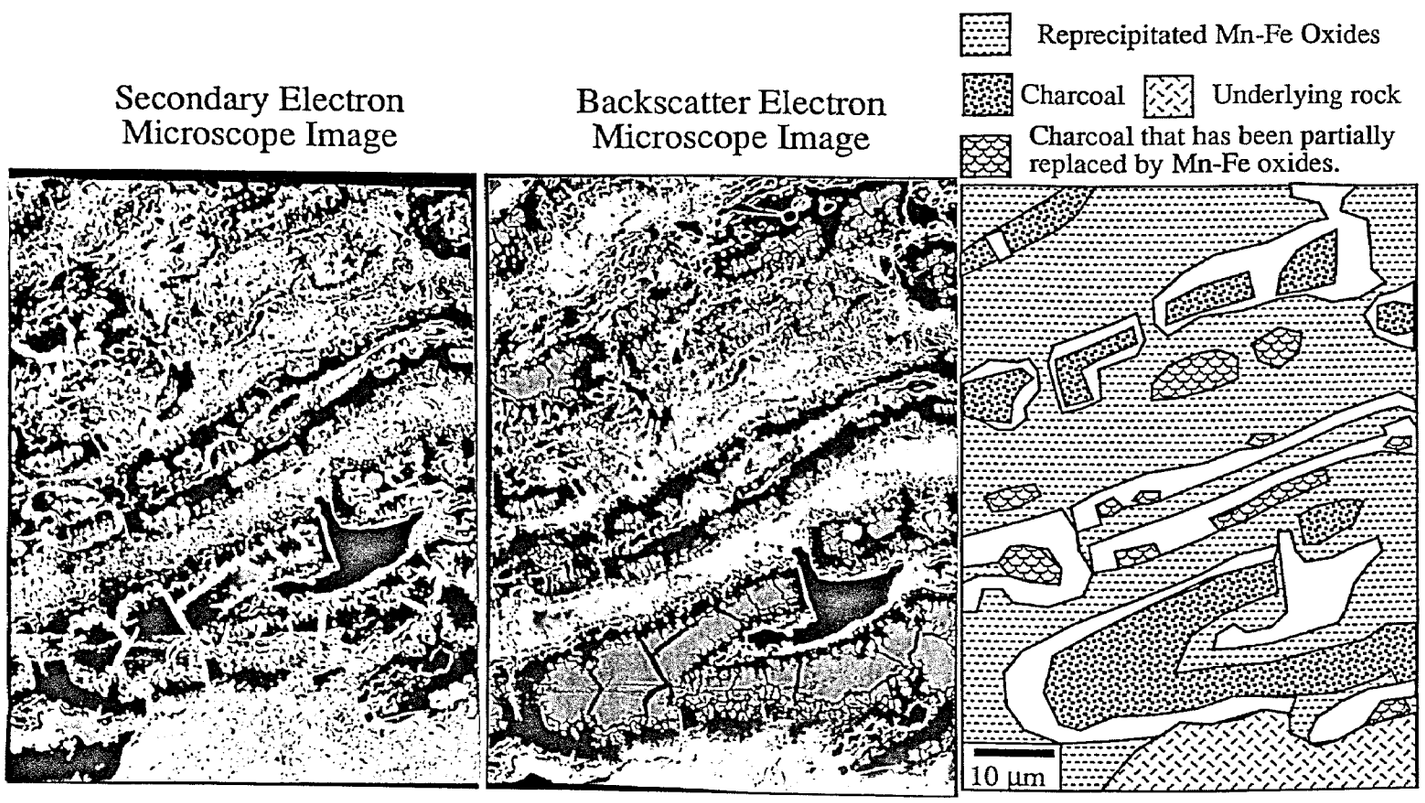

Figure 1. Appearance interface organics with the general appearance of shiny charcoal, encapsulated by rock varnish on petroglyph WH1. The scanning electron microscope image is of backscattered electrons, which reveals atomic number. The bright areas in the backscatter image are mostly manganese (Mn) and iron (Fe) oxides where woody tissue has been replaced by Mn-Fe. The layering pattern, of alternating Mn-Fe oxides and organic S, suggests that the charcoal-like material was probably not deposited all at once.

In petroglyph WH1, for example, most of the interface organics had a carbonized, charcoal-like appearance (Fig. 1) with some particles of filamentous, fibrous, and solid glassy carbon. The charcoal-like remnants were originally thought to be from resketching the art (Nobbs and Dorn 1993). However, the appearance of layering (Fig. 1). would be difficult to explain by resketching.

There are two other explanations for the presence of the charcoal-like and other highly carbonized material. First, "wind transported charcoal" is trapped by rock coatings in Australia (cf. Watchman 1992a:64). Second, the plant material known to be trapped by varnish (Watchman 1992b; Nobbs & Dorn 1993) undergoes diagenesis over time. Karlov (1961:1428), for example, observed "particulate infusions of a coal-black mineral substance" trapped under "desert lacquer" in the Black Sea region. Some of the diagenetic changes are quite similar to what is seen in some desert soils. For example, Chitale (1986:iv) found an "abundance of vitrinite and inertinite" in calcrete. Organic matter diagenesis may be accelerated by high temperatures on varnished rock surfaces that can reach 80°C (George 1976:231), by the Maillard reaction (Shuichi & Ryoshi 1989), and by the clay minerals (Collins *et al.* 1995; Wang & Lin 1993), manganese oxide birnessite (Wang & Lin 1993) and iron oxides (Jones & Jarvis 1981) that are all found in varnish in abundance.

Third, research in Portugal showed that older carbon can be added to petroglyph panels (Dorn 1997; Watchman 1995). Especially with the extraction of carbon from weathering rinds, the shallower engravings would be more likely to have 'inherited' older organics from a prior episode of weathering and diagenesis.

What are the implications of these uncertainties? It is not possible to rule out inheritance of organic matter in the host rock, or post-engraving additions of younger carbon. In sum, there is no guarantee that the ages in Nobbs and Dorn (1993) truly document when the petroglyphs were manufactured. The extent of the possible differences between the published ^{14}C dates and the real dates of manufacture cannot currently be estimated but might be considerable. Thus, there is a need for blind tests at petroglyph sites with independent age control — perhaps from excavation at the base of some of the Olary panels. Independent control might also come from cosmogenic ^{36}Cl (Phillips *et al.* 1997).

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