

# **PALAEOWORKS TECHNICAL PAPERS 5**

## **Macro Charcoal Analysis: A modified technique used by the Department of Archaeology and Natural History**

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### **Note**

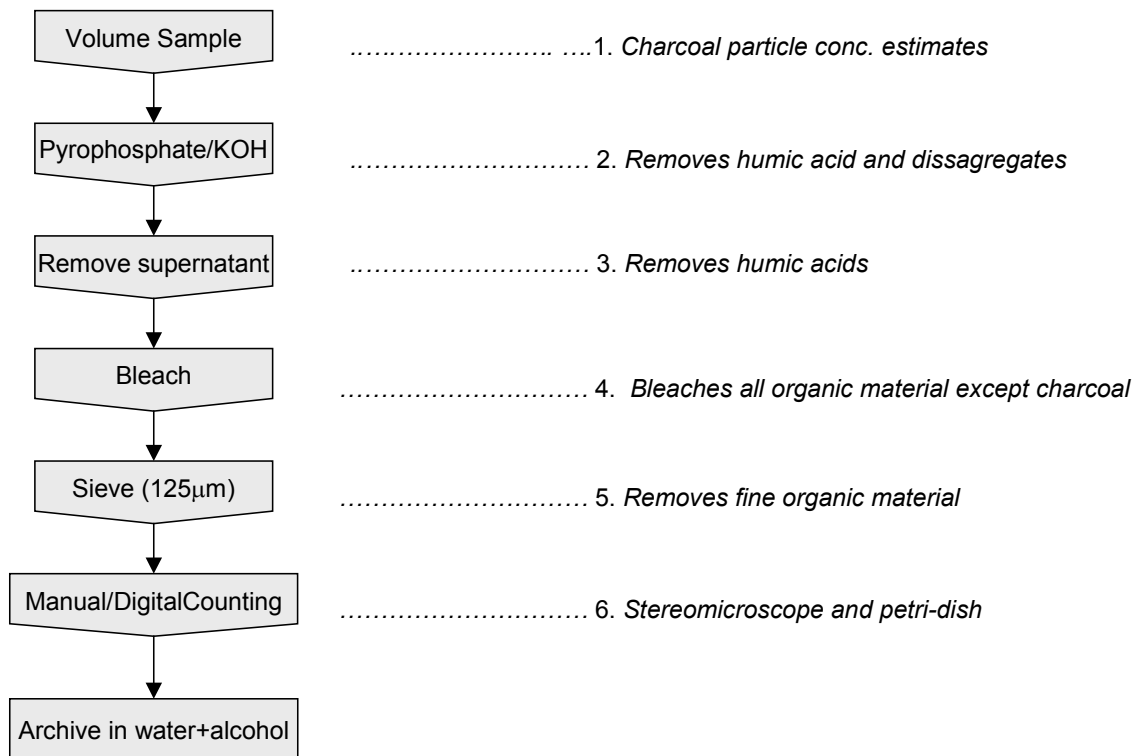
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# Macro Charcoal Analysis: A modified technique used by the Department of Archaeology and Natural History

## Introduction

The “macro charcoal” analysis outline here is designed to be carried out on contiguously sampled sediments; ie. the whole core is able to be analysed. The need to develop a fast, low cost method for charcoal extraction has arisen from the realization that low resolution analysis does not give an adequate indication of the frequency or concentration of charcoal being deposited in a sediment column. Continuous sampling enables the researcher to assess the frequency of charcoal peak events or episodes and therefore provides a window into the nature of past fire regimes. Different methods for charcoal extraction and analysis have been developed (see reading list below). Here we outline a method adopted at the Department of Archaeology and Natural History which is adapted from a method developed by Rhodes, A.N. (1995 A method for the preparation and quantification of microscopic charcoal from terrestrial and lacustrine sediment cores. *The Holocene* 8, 113-117.). Using this approach we have been able to complete extraction and analysis of around 32 samples in 2 half-day sessions in the lab.

## Outline of the Method



1) Measure out about 1-2 cc wet sediment into a test tube or sample vial.



2) Disperse in 5-10ml KOH or Sodium Pyrophosphate solution. Heat sample if rapid dispersal required or leave overnight. To achieve good separation of clumped sediment use a mechanical mixer or a very gentle stirring action with a stirring rod.

3) **Pour off and** discard supernatant after sediment settles.

4) Re-suspend in very dilute Hydrogen Peroxide (4-6% only), or alternatively Sodium Hypochlorite (4-6%), leaving it overnight. This is enough to bleach the organics excluding the charcoal.



5) Mix well and wet sieve this through a 125  $\mu\text{m}$  sieve (150/210/250  $\mu\text{m}$  or combination of these), and then put the coarse fractions back into a test tube in water. This can be stored until counting is done.

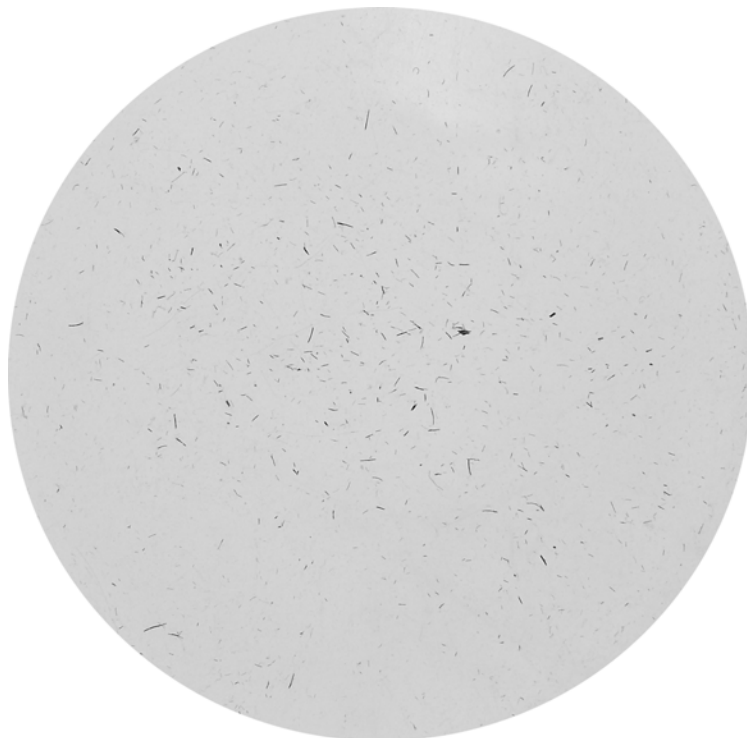


6) Pour the solution into a petri dish with graph paper underneath and place under a binocular microscope (approx. x10-15 magnification). Count the angular black (opaque) particles. If there are few, count all of them. If there are many, then count a proportion of randomly selected squares on the graph paper and calculate the total charcoal fragments from this. The final result can be expressed as particles/unit volume.

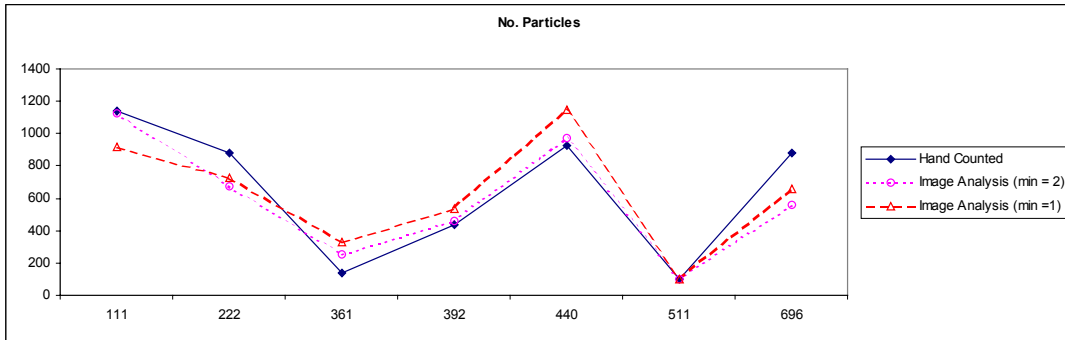


### **Digital Imaging of Macro Charcoal**

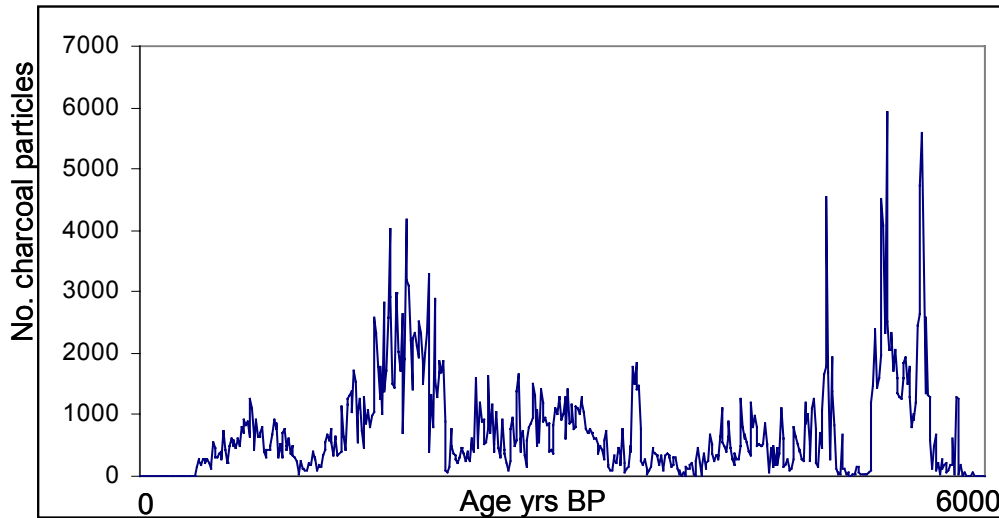
An alternative to hand counting is to photograph the charcoal with a digital camera. The image can then be analysed with free image analysis software available on the internet, such as image-J or Scion. Images need to be converted to grey scale to do this.



This figure illustrates a test that was carried to compare hand counts and image analysis counts using image-J.



This figure illustrates the raw data from a contiguously sampled sediment core for macro-charcoal. This data can then be smoothed or explored for cycles using spectral analysis.



## Charcoal Reading List

**Best Overview** – handed out at charcoal lecture.

Whitlock, C. and Larsen, C. 2001. Charcoal as fire proxy. In Smol, J. P., Birks, H. J. B. and Last, W. M. (editors) *Tracking Environmental Change Using Lake Sediments: Volume 3: Terrestrial, Algal, and Siliceous Indicators*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

### The Australian Environment - Charcoal/Fire studies

- Bickford, S and Gell, P. Holocene vegetation change, Aboriginal wetland use and the impact of European settlement on the Fleurieu Peninsula, South Australia. *The Holocene*. 15(2):200-215, 2005 Feb.
- Bowman, D. M.J.S. 1998. Tansley Review 101. The impact of Aboriginal burning on the Australian biota. *New Phytologist* 140, 385-410.
- Bowman D.M. 2000. *Australian Rainforests – Islands of Green in a Land of Fire*. Cambridge, Cambridge University Press 345pp.
- Bowman, D.M.J. and Brown, M.J. 1986. Bushfires in Tasmania: a botanical approach to anthropological questions. *Archaeology in Oceania*, 21, 166-171.
- Clark, R.L. (1982). Point count estimation of charcoal in pollen preparations and thin sections of sediments. *Pollen et Spores*, 24, 523-535.
- Clark R.L. 1983. Pollen and charcoal evidence for the effects of Aboriginal burning on the vegetation of Australia. *Archaeology in Oceania* 18, 32-37.
- Clark, R.L. 1983. The prehistory of bushfires. 61-74 in Stanbury, P. (ed.), *Bushfires, their effect on Australian life and landscape*. Sydney, Macleay Museum, Univ Sydney.
- Haberle S.G., Hope G.S., van der Kaars S. 2001 Biomass burning in Indonesia and Papua New Guinea: natural and human induced fire events in the fossil record. *Palaeogeography Palaeoclimatology Palaeoecology*. 171(3-4):259-268.
- Hope G. 1999. Vegetation and fire response to late Holocene human occupation in island and mainland north west Tasmania. *Quaternary International*. 59:47-60.
- Hopkins, M.S., Ash, J., Graham, A.W., Head, J. and Hewett, R.K., 1993. Charcoal evidence of the spatial extent of the Eucalyptus woodland expansions and rainforest contractions in north Queensland during the late Pleistocene. *J. Biogeography* 20: 357-372.
- Hopkins, M. S., Graham, A.W., Ash, J. and Head, J. 1990. Evidence of Late Pleistocene fires and eucalypt forest from a North Queensland humid tropical rainforest site. *Australian Journal of Ecology*. 15, 345-347.

- Kershaw, A. P., 1994. Pleistocene vegetation of the humid tropics of northeastern Queensland, Australia. *Palaeogeography, Palaeoclimatology and Palaeoecology*, 109, 399-412.
- Moss, P.T. and Kershaw, A.P. 2000. The last glacial cycle from the humid tropics of northeastern Australia: Comparison of a terrestrial and a marine record. *Palaeogeography, Palaeoclimatology, Palaeoecology* 155, 155-76.
- Turney, C.S.M., Kershaw, A.P., Moss, P., Bird, M.I., Fifield L.K., Creswell, R.G., Santos, G.M., Di Tada, M.L., Hausladen, P.A. and Zhou, Y. 2001. Redating the onset of burning at Lynch's Crater (North Queensland): implications for human settlement in Australia. *Journal of Quaternary Science*. 16(8):767-771.

### **Other Papers of Interest**

- Anderson, R.S. and Smith, S.J. 1997. The sedimentary record of fire in montane meadows, Sierra Nevada, California, USA: a preliminary assessment. In J.S. Clark, H. Cachier, J.G. Goldammer and B. Stocks (eds.), *Sediment Records of Biomass Burning and Global Change*. Berlin, Springer Verlag.
- Clark, J. S. and Hussey, T.C. (1996). Estimating the mass flux of charcoal from sedimentary records: effects of particle size, morphology, and orientation. *The Holocene*, 6, 129-144.
- Clark, J.S. and Royall, P.D. 1995. Transformation of a northern hardwood forest by aboriginal (Iroquois) fire: charcoal evidence from Crawford Lake, Ontario, Canada. *The Holocene* 5, 1-9.
- McDonald, G.M., Larsen, C.P.S., Szeicz, J.M. and Moser, K.A. 1991. The reconstruction of boreal forest fire history from lake sediments: a comparison of charcoal, pollen, sedimentological and geochemical indices. *Quaternary Science Reviews* 10, 53-71.
- Patterson, W.A., Edwards, K.J. and Maguire, D.J. 1987. Microscopic charcoal as an indicator of fire. *Quaternary Science Reviews* 6, 3-23.
- Shackleton, C.M. and Prins, F. 1992. Charcoal analysis and the "Principle of least Effort" - a conceptual model. *J. Archaeological Science* 19, 631-637.
- Thevenson, F. Bard, E. Williamson, D and Beaufort, L. 2004. A biomass burning record from the West Equatorial Pacific over the last 360 ky: methodological, climatic and anthropic implications. *Palaeogeography Palaeoclimatology Palaeoecology*. 213(1-2):83-99.