An Exceptionally Brief Note on Spherical Carbonaceous Particles
(Fly ash, Inorganic ash spheres) Compiled by Allan Clark

In the past few years I have seen many masters students or undergraduates doing dissertations who are struggling to find plain transmission light microscopy images of SCPs, (most papers are always S.E.M. photos). Many go on to incorrectly identify materials in their samples as SCPs. A good start would be to make sure you are aware of the different types of fly ash, such as inorganic ash spheres (IAS) and spherical carbonaceous particles (SCPs). A very basic introduction to these can be found with good S.E.M. photos in **Smol, J.** (2002) Pollution of lakes and rivers: a paleoenvironmental perspective. Oxford University Press. pp280.

I hope this rough little note may be of use for all concerned.
However, this is *my* interpretation of what SCPs look like in transparent light microscopy (non-reflective), and you may well develop your own.

The following is a short compilation of images that I have taken from a series of lake sediments sourced from the centre of Llyn Llagi, Snowdonia, Wales. The slides were set in naphrax using the HF technique described by **Rose, N. L.** (1994) A Note on Further Refinements to a Procedure for the Extraction of Carbonaceous Fly-ash Particles from Sediments. *Journal of Paleolimnology*. 11 (2): 201-204.

Otherwise, the use of SCPs and fly ash has been very well documented, and there is plenty of information out there.

A few basic points to get you started:

1) SCPs usually appear between 1 to 50 microns in diameter.
2) They appear black/opague, but may possible have holes and a lacy texture.
3) The perimeter should be very smooth, indeed… it should be spherical!
4) If you there is any doubt of the particle being an SCP, the rule is that you do not count it as one.
5) More remote areas will have smaller diameter SCPs (of course this is dependent on source, prevailing wind direction, fuel burned etc…etc…).
6) The size of SCPs alters with any chronological stratigraphy. This is to say that as the dominance of oil over coal emerges, the types of fly ash particles you find will change.
7) If you focus in and out, the focal distance will show that it is indeed a 3 dimensional spherical particle (see plate 10).

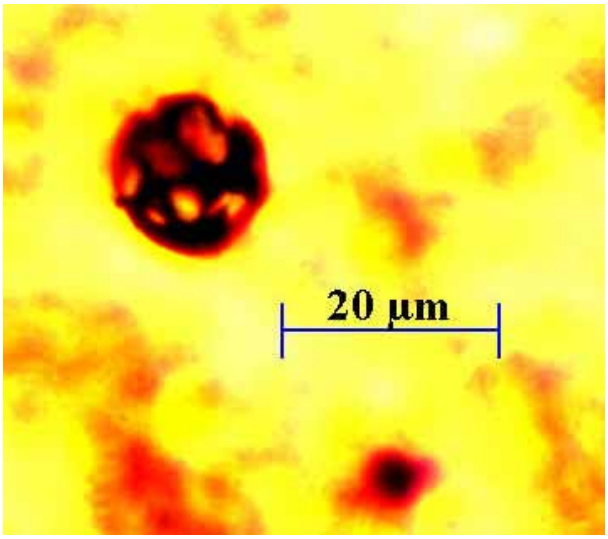
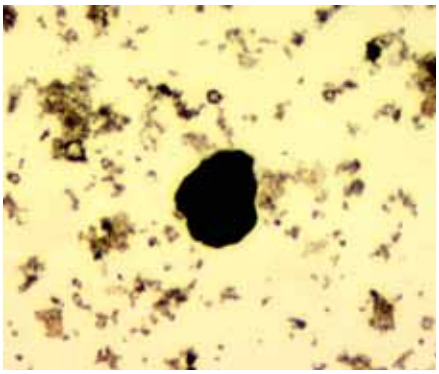


Plate 1 (left): What I believe to be a true SCP.

Plate 2 (below): This is not an SCP, it is not spherical.



Some particles may display a type of porosity or lattice work texture. I believe that these are mainly oil produced SCPs, while other, more solid black soot particulates are more likely to be IASs.

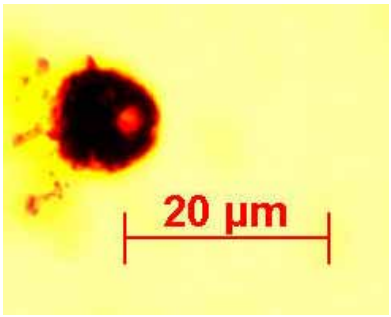
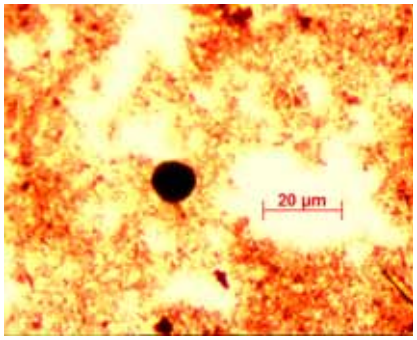


Plate 3 (left): SCP with lattice work/porosity.

Plate 4 (right) : Potential SCP with a more solid Structure.



The black particles in plates 5 & 6 are too angular to be SCPs (sorry I did not put a scale on):

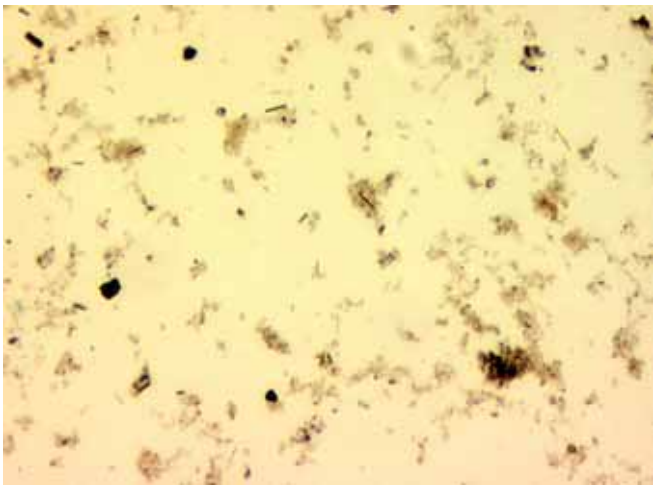


Plate 5: Black angular grains.

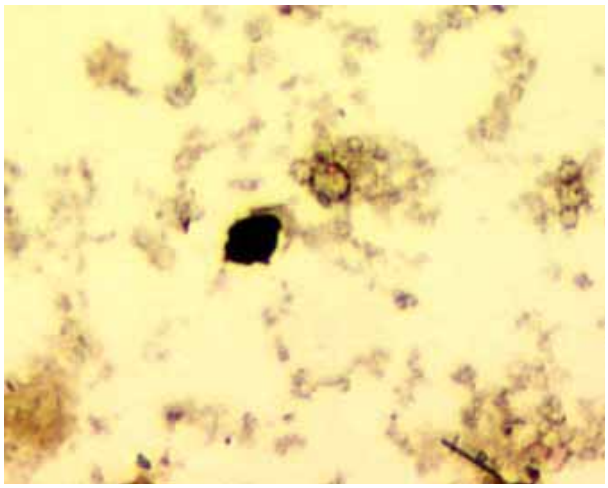


Plate 6: Black angular grain.

The following couple of plates (7 & 8) show some rather nice looking SCPs, spherical, opague, a common size etc….

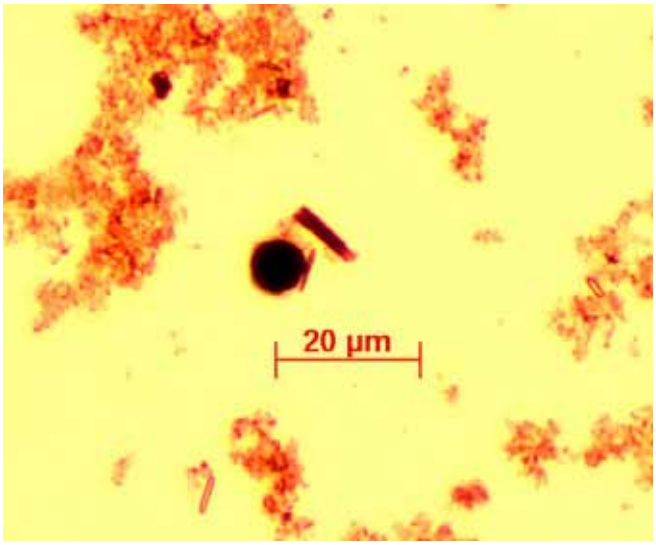


Plate 7: Typical SCP.

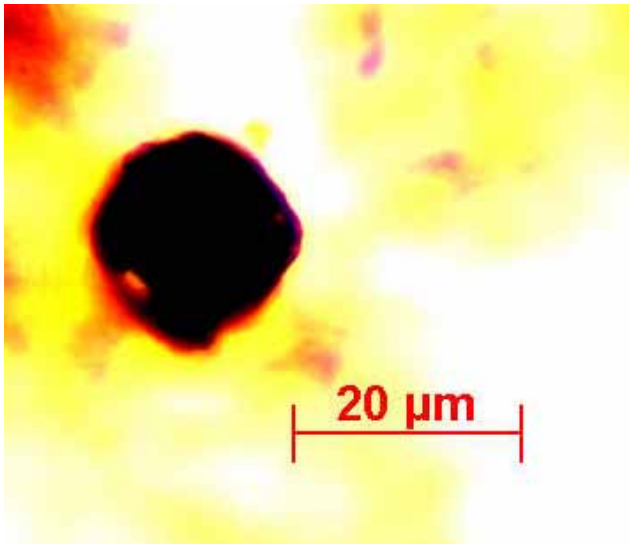


Plate 8: Another SCP.

Finally, remember that SCPs are spherical in the 3d plane! You can always focus in and out and see the shape of the particle that you are looking at, as it moves in out of focus as shown in plates 9 and 10.

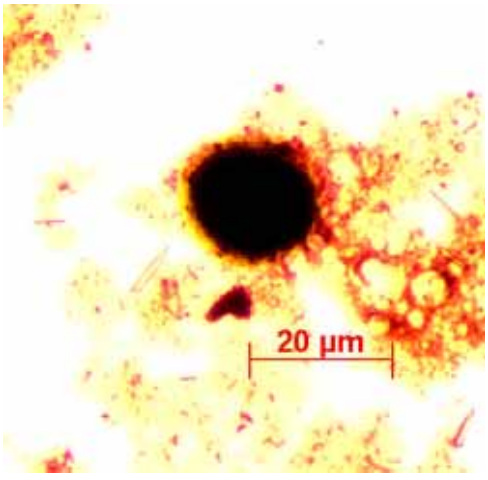
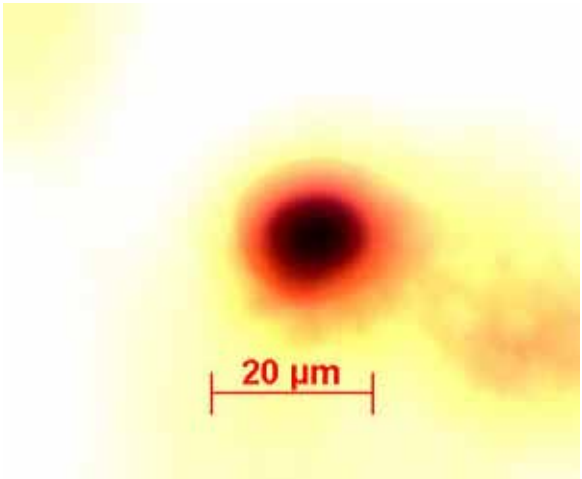


Plate 9 (left): Potential SCP in focus.

Plate 10 (right): Blurring of perimeter and sharpening of centre as focus moves in and out.



I would recommend that you look at a few different samples including one where there should not be any SCPs etc. (eg. if a lake sediment core, a sample that represents a time further down the core before the onset of the industrial era), this will help you distinguish between what is in your sample (eg. pollen) and what are true SCPs and IASs. *GOOD LUCK – Allan *